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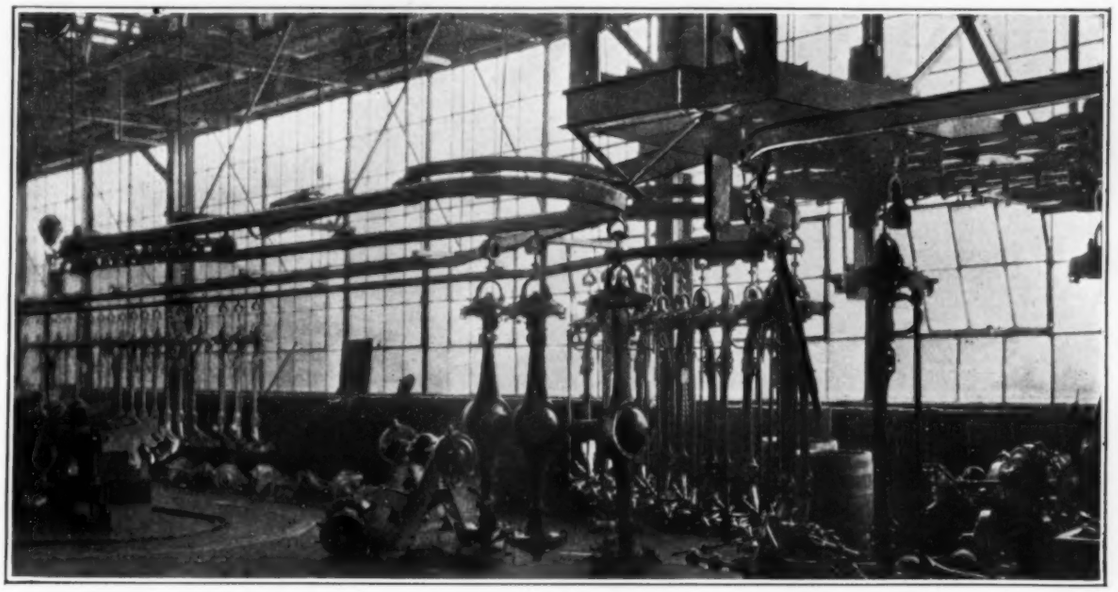


Conveying Sub-Assemblies in the Oakland Plant

By Howard Campbell
Western Editor, *American Machinist*

Output of modern production plants largely dependent on methods of handling stock—Departments laid out to facilitate material handling—Conveying motors and axles by overhead conveyor

THE ever-increasing importance of having materials delivered at the point where they are to be used, at the time when they are needed, has resulted in the development of a separate branch of engineering for this work. Modern high-speed production methods are effective only when stock is available at the precise spot where it is needed and in such quantities as will permit of continuous production without transforming the working space into storage space. The material-handling equipment of the Oakland Motor Car Co., Pontiac, Mich., includes some interesting conveyors, which are described herewith.

A great number of the standard type of roller conveyors are used throughout the machine shop to transfer materials between operations, and it is only when the materials arrive at the assembly stage that we find unusually interesting equipment. As the crank cases and cylinders leave their respective machining departments, they meet on the angle-iron slide shown in Fig. 1. Rows of workmen face the slide on both sides, each man performing his operation on the motor as it comes along, and pushing it on to the next man when he is through with it. Stock parts which are to be used in assembly are kept in two rows of bins which parallel the slide, within easy reach of the operators. By the time the gears, gear-case cover, and valves have been assembled to the cylinder, it has reached the end of the slide and is lifted by means of an Ingersoll-Rand "Little David" pneumatic hoist and placed in the motor stand shown in the foreground. These stands are supported on wheels, and each stand has a guide attached to the under side so that it can be pushed along from one operator to the next without deviating from the assembly line. The guide is slotted and sets over the vertical side of a section of angle iron that is fastened to the floor. A second line parallels the first, so that the stands can be returned to the starting point. Sections of channel iron to guide the wheels of the stands connect the two lines at the ends.

When the motors reach the end of the assembly line,

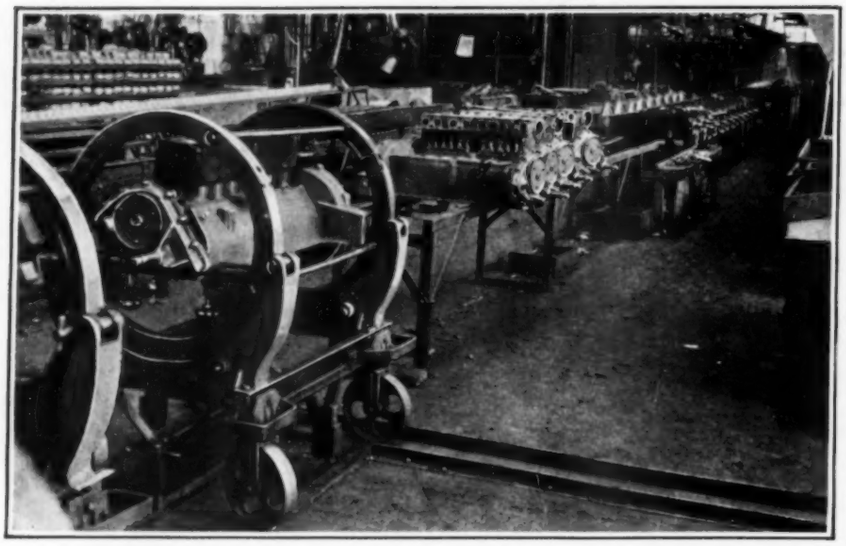


Fig. 1—Motor assembly department showing slide and motor stand

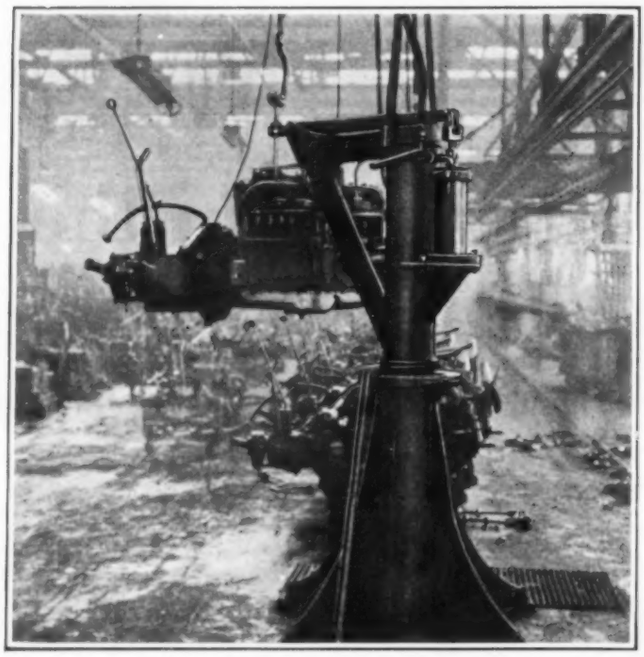


Fig. 2—Motor transfer crane

they are placed into hand trucks and moved into the block test, which is located directly at the end of the assembly department. After the test, the motor is picked up by an overhead crane and swung into position on the pneumatic crane shown in Fig. 2. The motor is lifted by means of a long stud, designed as shown in Fig. 3, and screwed into a spark-plug hole. A forked hook on the overhead crane engages the head of the stud, and a fork on the end of the arm on the stationary crane engages the ball when the transfer is made. The overhead crane then moves away and the stationary crane is swung around so that the head of the stud can be caught by a carrier on a conveyor line as shown in Fig. 4. As the carrier on the power conveyor comes along, the stud is placed in position, and the release valve on the crane opened. The arm moves down, allowing the weight of the motor to rest on the carrier. As the carrier continues on its way, the motor passes from the crane arm which is swung back to receive another motor.

The power conveyor line comes into the machine shop and turns at a point where it is available to both the motor test department and the front and rear axle assembly departments, which are connected to it by means of monorail lines. A view of the front axle assembly department can be seen in Fig. 5. Each axle is placed in a portable stand and is pushed along from one operator to the next as the various parts are assembled to it, being guided by a section of channel iron on the floor, in which the two wheels under one end of the stand travel. The channel is continuous, as shown in Fig. 6. The axles are placed on the stands at the farther end of the department and pass between two rows of workmen, each of whom performs his operation and passes the axle on to the next. As the axle reaches completion, it arrives at the end of the department nearest the power conveyor, where an attachment bearing a stud that is similar to those used to handle motors, shown at *A*, Fig. 7, is attached to the axle by means of capscrews, making use of the holes tapped for the disk wheel screws. The axle is then raised by means of a "Little David" hoist and swung into position in one of the carriers on the monorail line, where it is pushed along by hand until it comes within reach of the swinging arm *B*. This arm is pivoted at a point that is central between the monorails and power conveyor as shown in Fig. 6, so that the operator can pick the axle off the monorail and swing it around where the head of the

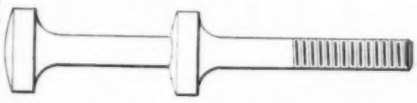


Fig. 3—Stud used to hoist motors

Fig. 4—Hanging motor on power conveyor

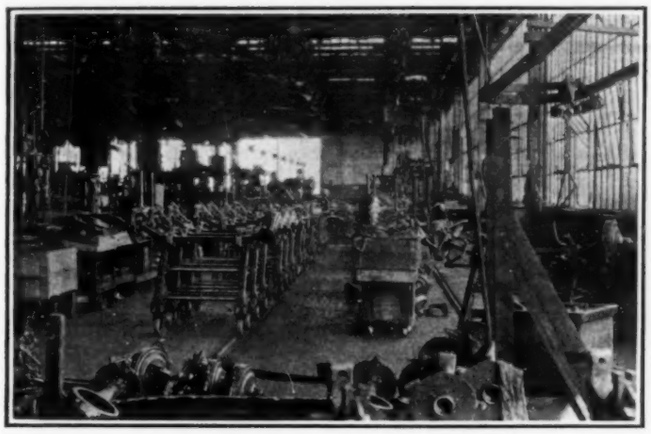


Fig. 5—Front axle assembly department

are taken off and hoisted to the main floor to be used in the final assembly. A crane similar to that shown in Fig. 4 is used to take the motors off the power conveyor line as they come along, each one being immediately attached to a hook suspended from an air hoist which is shown in Fig. 8, and hoisted through an opening in the floor to the final assembly department. The air hoist with which this is done is attached in a horizontal position to a steel framework which is suspended from a monorail, as shown. A handle extends downward from the framework so that when the motor is hoisted to the proper height, the hoist frame can be moved over to a point where the motor can be dropped onto a portable rack until such time as it is needed for assembling to a chassis. Having a number of motors on hand at this point relieves any trouble which otherwise might develop by reason of failure of either the power motor conveyor or the assembly line. The motors are

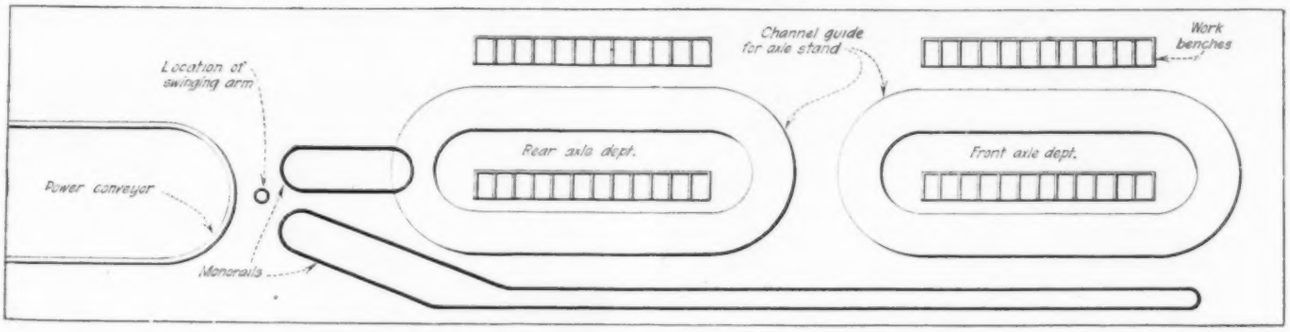


Fig. 6—Sketch showing layout of departments

stud can be placed in position in one of the carriers on the power conveyor. A general view of the monorail systems and their proximity to the power conveyor is shown in the headpiece.

The workman who hangs the front and rear axles on the power conveyor usually contrives to load one of each and then leave a carrier which will be loaded with the motor, thus providing one front, one rear axle and a motor in the proper sequence. This conveyor passes down an incline to the basement and travels several hundred feet to the point where the motor and axles

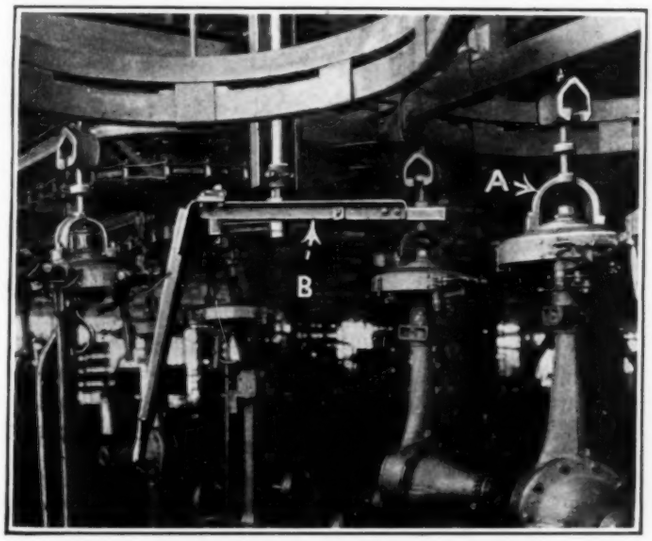


Fig. 7—Transferring axles from monorail to power conveyor

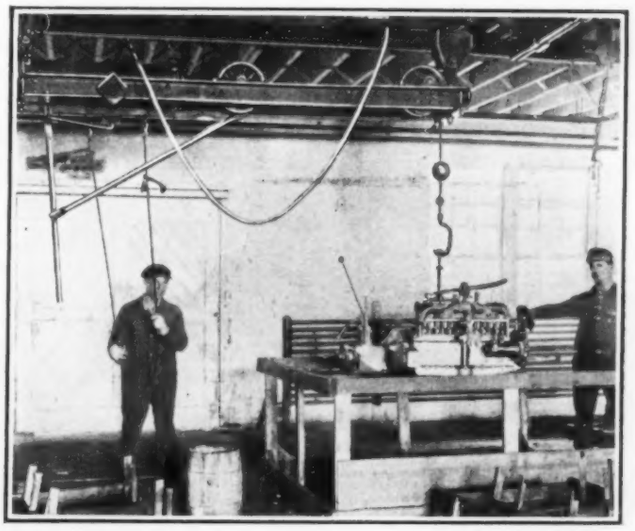


Fig. 8—Hoisting motor to asembly floor

later hoisted again by means of a pneumatic hoist and dropped into the chassis on a power assembly conveyor of the usual type.

These time and labor saving devices are important items in cutting down that bugbear of all production managers, indirect labor, frequently but erroneously called, non-productive. Nor is the cost of this indirect labor the only item to be considered. Equally important is the advantage of having a steady flow of parts to the assembly line, as interruptions there cause congestion all along the line and delay the output of the finished product.

An Example of the Ancient Art of Brass Turning

By Milton Wright

IN THESE days of modern machinery when there are mechanical means for producing pretty nearly every commodity that the world wants, the once flourishing

Fig. 1—Turning the outside of a gong-bell

trade of the brass turner has shrunk to comparatively small proportions. About everything he used to make is now turned out on an automatic machine for "nothing and the chips," or someone has devised a way of drawing it up from sheet metal or of upsetting it from the wire and thus eliminating even the chips. There is,

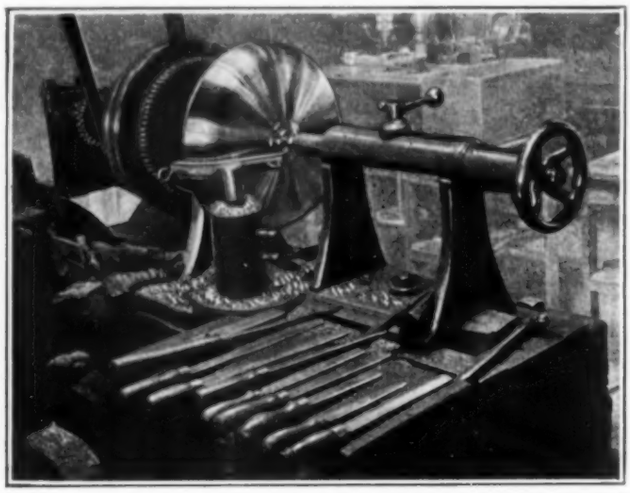


Fig. 2—Lay-out of tools used by the turner

however, one item that is still produced in large quantities and in much the same manner as in times past.

In the busy little town of East Hampton, Conn.—the "bell-town" of the world—the Bevins Bros. Mfg. Co. has been making bells of all sorts, descriptions and sizes, up to tower bells of 250 lb. weight, since the year 1832, and in this shop at least the brass turner still holds his accustomed place and prestige.

The equipment for turning bells consists of a lathe—any kind of a lathe that has a headstock, a tailstock and a toolrest—various shapes of hand tools, usually made from old files, sundry pieces of sandpaper, and the skill of the turner, this latter by far the most important item.

A "chuck," which is a suitably sized block of maple or other hard wood attached to a cast-iron center or drive-plate, is screwed on the nose of the lathe spindle and turned by hand approximately to fit the contour of the inside or outside of the bell, according to which is to be finished. Except tower bells, however, bells are rarely turned on the inside, and in the case of the exceptions the inside finish extends only far enough to make the metal at the mouth of the bell of even section. Having trued up his chuck, the workman puts a casting in place upon it, runs the tail center up against the casting with sufficient pressure to insure the necessary

Fig. 3—Some of the "chucks" used in turning bells

friction between wood and metal to drive against the cut, and proceeds to shape the outside. If any part of the interior is to be finished he substitutes an "inside" chuck, reverses the casting and completes the job in the same way.

Of the illustrations, Fig. 1 shows the turning of a large gong, of which class bells are made up to 36 in. in diameter. Fig. 2 shows a layout of the tools that are used, and Fig. 3 some of the hardwood chucks. No contour gages are needed and few measurements are taken, the workman being guided entirely by his eye and the tone of the bell when struck.

Ordinarily the tone of such a bell with reference to the musical scale, is of little importance so long as it rings clear, but when necessary it may be very accurately controlled over quite a wide range by removing metal from the center or rim to make it "flat" or "sharp" respectively.

A Workable Production Control System

By Edward Davis
Production Manager, Edison Phonograph Works

How production is planned—Determination of interdepartmental shipment periods and amounts—The economic set-up—Production rates determined by department heads—Raw material control

THE production plan, that is, the determination of the design of a phonograph part and the methods used in its manufacture, is made out by the engineering department, as mentioned in the preceding article. This work includes all changes in old parts, as well as the planning of production of new parts. The data prepared by the engineering department gives the routing of the part through the shops and lists all the operations to be performed by the various departments. These instructions are issued by the use of an engineering notice, a routing or operation sheet, and a blueprint of the part.

The engineering notice gives the authority for making the piece, assigns the part number and name, and describes the place where it is to be used. If the new part supersedes another, the part it is to supersede is noted, together with the disposition of the superseded part or parts. The routing or operation sheet carries the part number and the name of the piece and the place where the part is used, then listing the numbers and names of the operations, together with the departments that are to perform these operations. The blueprints show the dimensions necessary for manufacturing, the kind of material to be used, the weight per thousand pieces and, in a "Where Used" column, the number of pieces required on each of the various models of machines manufactured.

All of these instructions, when issued by the engineering department, are sent to the producton department for release and distribution, this procedure preventing the making of changes prematurely and the consequent confusion in the shop. All copies are held in the production department file until the time for the change to become active arrives and the schedule sheet or shop orders are then issued accompanied by these copies.

Importance of Shipment Data

Since the basis of this system is periodic shipments of predetermined amounts of material between departments, the determination of these amounts and the shipment periods is of primary importance and must be done before a part can be scheduled in the shop. It is governed by two factors, sales requirements and the economic set-up. This brings up a feature of the plan that is somewhat novel and leads toward the maximum of co-operation between the production department and the manufacturing departments. Neither the number of pieces required to make an economic set-up of a machine, nor the rate at which parts can be produced, are settled by the production department. This is left to the deparment head himself, and puts the responsibility for the working of the final schedule upon him alone, where it belongs.

In other words, the production department does not pretend to tell how a department shall be run, but prepares, instead, a schedule based upon the information given by the department head, so that the work of the department will be co-ordinated with the rest of the shop. A few examples will show how the times and amounts of shipments are determined.

How Shipments are Scheduled

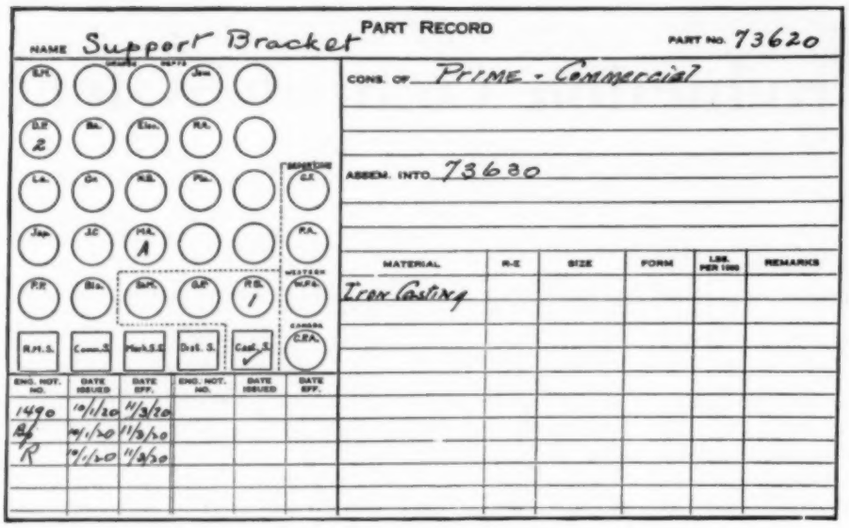
Let us assume that 1,000 top plates are required per day. This is the largest iron casting used on the musical phonograph and 40 operations are required on the piece, the operations being divided between the "Polish & Buff," "Japan" and "Drill Press" departments. By inquiry we find that it takes a number of men to perform the operations in each department, and any amount over 250 would be an economic run, so they are scheduled for daily shipment, each shipment to total 1,000 pieces.

As another example, suppose 500 support brackets of a certain type are required per day. This is a smaller casting and travels through the same three departments, but the operations are fewer and more simple. The shipment of 500 each day would mean too many changes in machine set-up in the first department, so that 2,750 are scheduled to be shipped out once each week, and in the second and third departments 500 are scheduled for shipment each day, because 500 is found to be an economical run in each of these departments. Castings are considered a commercial article because they are purchased in units, so the store service department receives a copy of the schedule and delivers to the first department the quantity called for on that schedule periodically—1,000 top plates per day and 2,750 support brackets per week. These shipments from casting stores are made regularly in the same manner as those between the manufacturing departments.

For a third example let us consider the schedule for winding shafts of a certain type, of which 500 are required per day. This part is made from bar stock, the prime or first operation being performed in the screw machine department. In this case a shop order is necessary in order to draw out raw material and, since economy demands as few set-ups as possible during the year, a shop order is issued on the screw machine department calling for 48,000 winding shafts, or four months' supply.

The first operation in the next department is a short one, and daily or weekly shipments would not be large enough for an economic set-up, so that monthly ship-

This is the second article in this series. The first article was concluded on page 757, Vol. 60, No. 21.


NAME Support Bracket PART RECORD PART NO. 73620

CONS. OF PRIME - Commercial

ASSEM. INTO 73630

MATERIAL	R-E	SIZE	FORM	LBS. PER 1000	REMARKS
Iron Casting					

ENG. NOT. NO.	DATE ISSUED	DATE EFF.	ENG. NOT. NO.	DATE ISSUED	DATE EFF.
1490	10/1/20	11/3/20			
B	11/1/20	11/3/20			
R	11/1/20	11/3/20			

Fig. 9—Part record card

ments of 12,000 pieces are scheduled out of the screw machine department. It should be stated here that when monthly shipments are called for, it is understood by all to mean four times the amount called for on a weekly schedule, or twenty-two times the daily schedule. This is done in order to have an equal division of time and amounts.

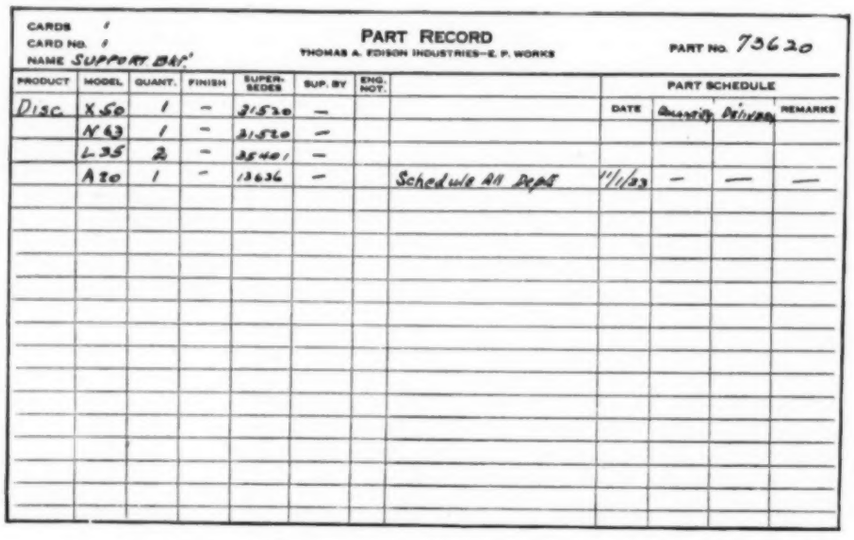
The operation in the third department is slow and, as it takes all of one operator's time to get out 500 pieces per day, the shipping schedule from the second department calls for 2,750 pieces to be shipped weekly. The next operation being the final assembly, where only 500 pieces can be utilized per day, the schedule in the third department also calls for 2,750 pieces to be shipped weekly. Weekly shipments in these cases are made in preference to daily shipments because the parts are not bulky and one shipment per week saves trucking.

These three examples illustrate the majority of cases. There are exceptions, however, and these will be dealt with as they come up in the further discussion of the plan. These deliveries, in the determination of which the general superintendent and the department superintendent are consulted, are subject to change only in the following manner: Should the department superintendent find after a time that the shipment he receives, or is supposed to make, is either too small, so that too much time is lost in changing the machine, or so large as to be unwieldy, he notifies the production department. An investigation is immediately made and, if it does not interfere with the best working conditions in other departments, the change is made. In this manner, every possible aid is given to the department superintendent in administering the affairs of his department. Moreover, this procedure assures the operator a reasonable amount of material that will permit his earning over the standard rate every time he goes on that operation.

There is, of course, the possibility that the general superintendent may request a change from the production department directly, but the request generally comes from the department superintendent, either on the advice of the general superintendent or works manager, or through his own observation. The rate adjuster may also find when checking up the time on operations, that the lot is too small to allow the operator an opportunity to do effective work and he will then consult the department superintendent. It must be apparent that, by reason of these regular amounts to be worked on at each period, not only are the operators better satisfied and consequently inspired to put forth better efforts, but the department superintendent is given a better opportunity to plan his work and select his operators, so that the whole shop operates in a more orderly manner.

Every executive who is familiar with manufacturing problems, knows that it is impossible to start 1,000 pieces through the shop and expect to always get 1,000 perfect pieces at the finishing end. Under this system the stockkeeper is not allowed to ship more or less than the specified amount and some provision must consequently be made for the shortages, caused either by defective material or poor workmanship. This is taken care of by "work-in-process" allowances in departments that require them, and the departmental stockkeepers draw on these allowances to make up the amount required for the shipments.

The amount of scrap or defective material is recorded by the chief storekeeper and a monthly report is sent to the works manager, general superintendent, department superintendent, and also to the production department. When the total rejections on any one piece reach an amount equal to a day's or a week's supply, depending upon the nature of the piece, an extra lot is brought through the shop, to make up the shortage in the work-in-process allowance. This is very easily done and the method employed will be explained when the operation of the control boards is discussed.


CARDS 1
CARD NO. 1
NAME SUPPORT BAR

PART RECORD
THOMAS A. EDISON INDUSTRIES—E. P. WORKS

PART NO. 73620

PRODUCT	MODEL	QUANT.	FINISH	SUPERSEDES	SUP. BY	ENG. NOT.		PART SCHEDULE DATE	QUANTITY DELIVERED		REMARKS
Disc.	X50	1	—	31520	—						
	N43	1	—	31520	—						
	L35	2	—	25401	—						
	A20	1	—	13636	—		Schedule All Depts	11/1/23	—	—	—

Fig. 10—Reverse of the part record card

The part record card has already been mentioned and is illustrated in Figs. 9 and 10. This card gives the history of the part in brief and is used only in the production department, where it is made out as soon as an engineering notice is released. The name and number of the part is entered, as shown in Fig. 9, together with what the part consists of, and what it assembles into. From the routing or operation sheet the necessary information about the operations and the departments that perform the operation is obtained, this information being shown in the circles at the left. Each of these circles represents a department of the works and by the use of symbols the routing of the part is easily and quickly shown.

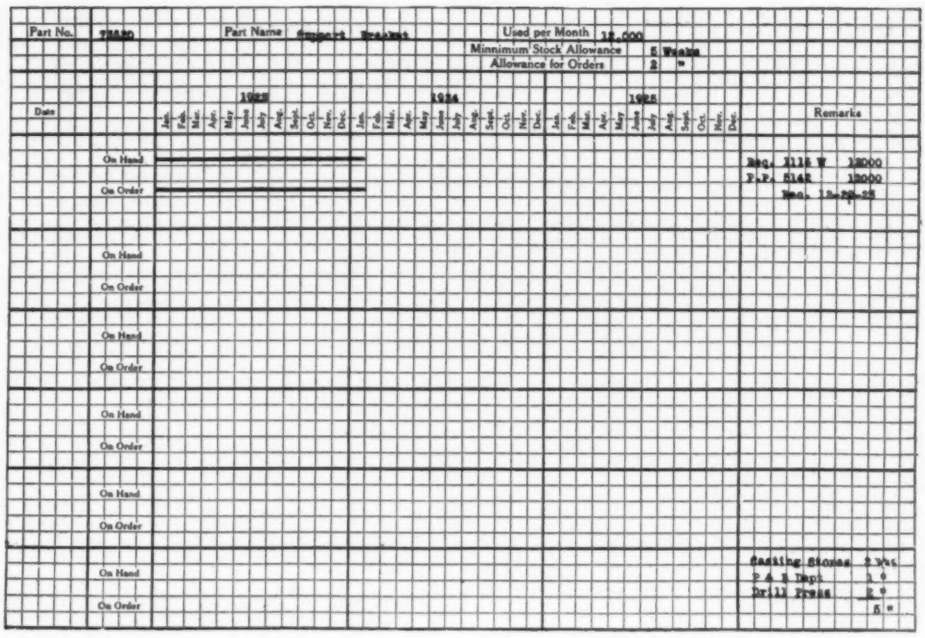


Fig. 11—Control sheet for commercial parts

For example, casting No. 73620 is received in the casting stores, signified by a check made in the square marked "Cast S." Operation 1 is performed in the "P-B" department shown by the figure 1 in the circle. Operations 2, 3, 4 and 5 are performed in the drill press department and the figure "2," signifying second department, is placed in the circle marked "D. P." Should operation 5 be the last operation prior to assembly, the assembling operation being performed in the mechanism assembly department, the letter "A" is placed in the circle marked "M.A." This record shows at a glance the route by which the parts travel through the shop. The information regarding material is then taken from the blueprint and entered under the proper headings. In the lower left-hand corner are entered the engineering notice number, together with the date issued and the date released. The routing sheet is signified by "R" and the blueprint by "B.P."

On the reverse side of the card, Fig. 10, is shown the product, the different models the part is used on, the quantity on each model, the finish, the part it supersedes and, if a further change is made, the part that it is superseded by, together with the engineering notice number that authorized the change. As shop orders become necessary, they are noted in the next column, together with the date on which the shop order is issued, the quantity, and the date on which the first delivery is required. This gives on one card all the information necessary to issue a shop order, as well as a condensed history of the part and a summary at any time of the shop orders issued for that part to date.

It is necessary that a good control system shall not only direct and record the progress of material in process, but that it shall also control the amount of raw material purchased and stocked. This procedure insures the possession of sufficient material in stock to keep the shop at work, and prevents the accumulation of excessive inventories. The raw material in our stock room is handled under two classifications, commercial parts and bulk material.

Castings, rubber gaskets, mica diaphragms, bottles, etc., are classified as commercial parts since they are purchased in units, and a control sheet for such material is illustrated in Fig. 11. This sheet gives the part number, the part name, the quantity used per month, the minimum stock allowance and an allowance for orders. Underneath are 36 squares representing the 36 months in three years, and below the names of the months the sheet is divided into six parts to take care of the possibility of that many changes in schedule during the life of a sheet. As an illustration of the use of this sheet, No. 73620 casting is used on several models of

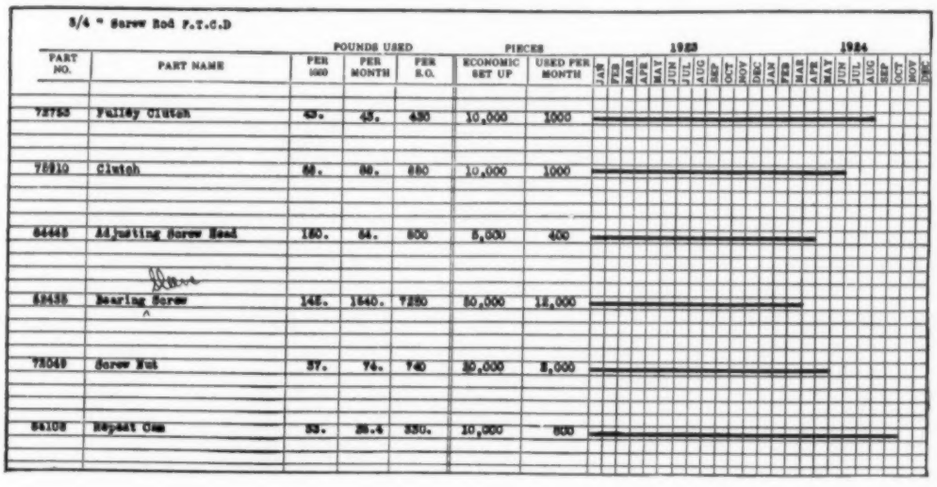

3/4 " Screw Rod F.T.C.D
PART NO.
PART NAME
POUNDS USED
PER 1000
PER MONTH
PER S.O.
PIECES
ECONOMIC SET UP
USED PER MONTH
1923
1924
72753 Fulley Clutch 43. 43. 430 10,000 1000
72810 Clutch 80. 80. 880 10,000 1000
84445 Adjusting Screw Head 180. 84. 800 5,000 400
83435 Bearing Screw 145. 1540. 7280 50,000 12,000
73049 Screw Nut 37. 74. 740 20,000 2,000
84108 Keyed Cam 23. 28.4 330. 10,000 800

Fig 12—Control sheet for bar stock

phonograph, the requirements being 12,000 per month, or 500 per day. This part is routed as shown on the part record card, Fig. 9, from "Casting Stores" to "Polish and Buff" and then to "Drill Press," from where it passes, when finished, into the mechanism assembly department for assembly.

Work-in-Process Allowances

The minimum stock allowance depends, of course, on the work-in-process allowances allotted to the various departments in which the part is handled, and these allowances are noted in the lower right-hand corner of the sheet. The operation in "Polish and Buff" is a short one, so only one week's production is allotted for the work-in-process allowance. In the drill press department the four operations require about four days for the completion of a week's supply and, as rejections are likely, a two weeks' allowance is made. We now have a total of three weeks' allotment in work-in-process, equal to 8,250 pieces and, since the conditions surrounding the purchase and delivery are such that castings can be obtained one week after the purchase order is issued, a further two weeks' allowance is made for orders.

If, on December 1, 1923, we have on hand in the shop and casting stores a two months' supply, the "On Hand" line can be drawn out to include January, 1924, as shown in Fig. 11. There being none due on order, the "On Order" line is also drawn up to include the same period. These forms are filed in a binder in the production department and the chief storekeeper in charge of commercial stores has copies. The sheets are gone over once each month and we can assume that on January 1 the storekeeper makes out a requisition for a month's supply, 12,000 pieces, and forwards it to the production department. If the two records agree, the requisition is recorded and passed on to the proper authority for final approval, after which the purchase order is made out and a copy is sent to the production department. A record is made by extending the "On Order" line to include February, 1924, and, under "Remarks," the requisition and purchase order numbers are entered. The copy of the purchase order is then forwarded to the receiving department for checking purposes.

When the castings are received, the receiving department makes out a tally sheet and sends it to the production department where the material is credited by extending the "On Hand" line. The tally sheet is then forwarded to the billing department. In this way the production department is kept in touch with the entire situation as regards commercial parts, without putting the purchasing and receiving departments to the trouble and expense of making extra copies, and a lot of unnecessary filing is saved.

Bar and Sheet Stock Control

Bar and sheet stock is an entirely different problem. A casting is generally used for a single purpose, but a bar of ¾-in. cold-rolled steel could be cut up into any one of six parts used in our product. The important question in this case is what amount should be carried in stock, and the ordinary answer to that question would be two or three months' supply. The failure in that method of keeping material can be shown, however, by a concrete example.

The material control sheet for ¾-in., free-turning, cold-drawn screw rod is illustrated in Fig. 12, and by totalling the "pounds used per month" column it is found that a month's supply is 1,935.4 pounds. Three months' supply at that rate would be 5,806.2 lb. If it was necessary to issue a shop order on part No. 62435, an economical run could not be made, because the 50,000 pieces would require 7,250 lb. of material, resulting in a shortage of 1,343.8 lb., even though the entire three months' supply was on hand intact. On the contrary, if an order for No. 62435 had just been completed, it would not be necessary to have 5,806 lb. of ¾-in. screw rod to take care of the balance of the parts made from that size material, since 3,545 lb. would be about a year's supply.

Economical Set-Up Determines Control

Therefore, as it takes approximately eight weeks to get cold-rolled steel from the mills, the more economical method is to study the requirements and the peculiar conditions surrounding the machining of the various parts, in order to establish the most economical set-up. These figures can then be made a part of the control record and the material can be ordered several weeks ahead of the average delivery period, thus insuring the availability of an adequate supply at all times, without undue waste in large inventories.

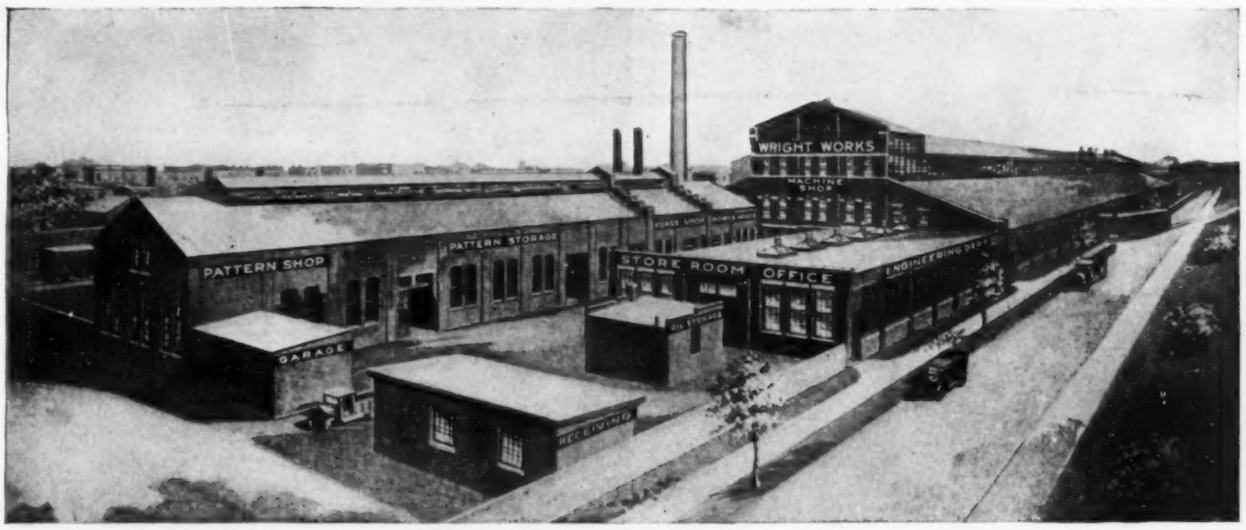
The same method is applied to flat stock, used principally in the punch press department, with one exception. On a screw machine using bar stock, the original set-up on a run is the controlling cost, because the necessary grinding of tools during the run costs but little in lost time. On a punch press, however, the cost of taking out a die for regrinding before a run is completed, and the resetting of the die after grinding, very often equals the cost of the original set-up. To this must be added the loss in idle machine time, or the moving of material if a die for another part is put in the press while the first die is being reground. Taking these conditions into consideration, it is apparent that the economic set-up is the capacity of the die with one grinding.

Figures Changed by Department Heads

These figures are placed on the control sheet under the heading "Economic Set-Up" and are changed only upon request of the department superintendent. Incidentally, he is expected to operate according to these figures, because he established the amounts, and the production control sheets will very quickly show whether they have been lived up to or not.

Another considerable saving is made possible in the punch press department by following the above method. In the case of an expensive die, such as those used for electric motor armatures and field laminations, long experience has established the fact that with the material we use, 100,000 pieces is a fair run for the die after grinding, and 600,000 pieces are used per year. On an order for 150,000 pieces, 100,000 would be made after the first grinding and 50,000 after the second and, since it is a custom to grind the die each time it is set up, eight grindings would be necessary during the year. However, if 100,000 pieces were ordered each time, only six grindings would be necessary, thereby adding 25 per cent to the life of the die.

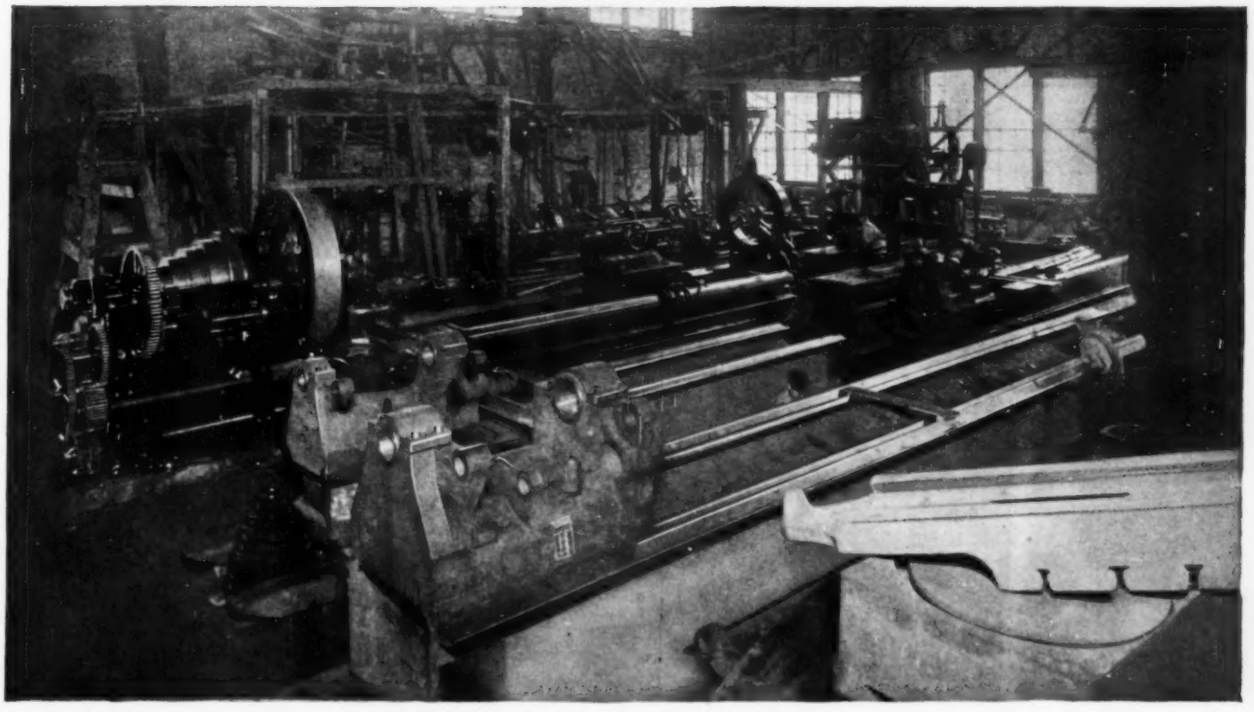
The next article will consider the details of the control of production by orders and schedules and the visual record used in shop and office for checking shipments of materials and parts between the departments.

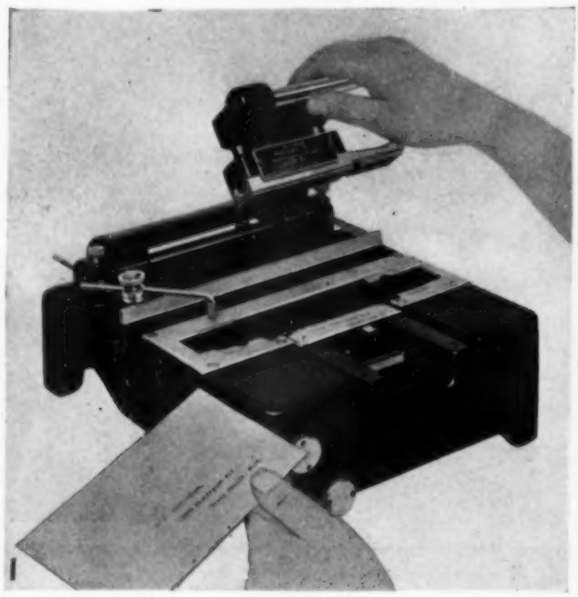


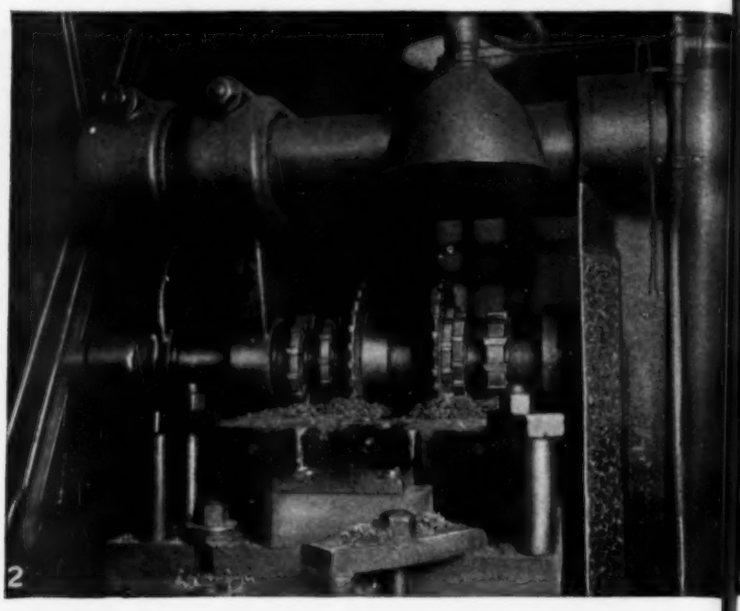
Where Machine Tools Are Made

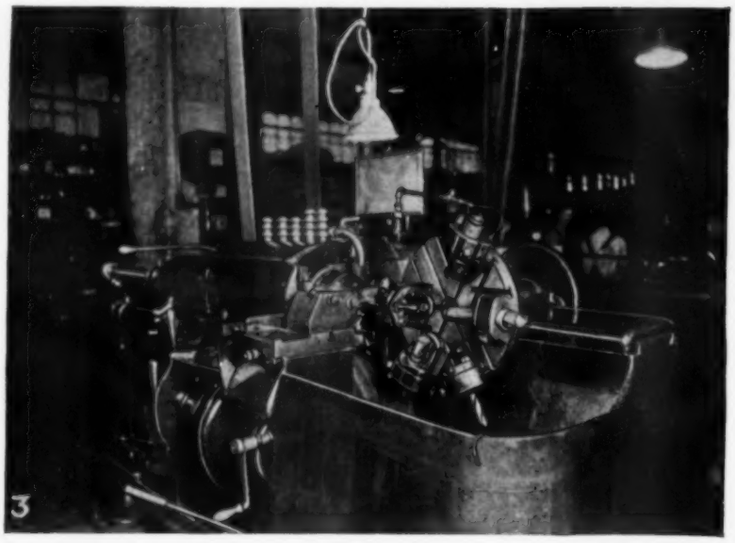
David A. Wright, Inc.
Chicago, Ill.

Founded 1914









Machine Work to S

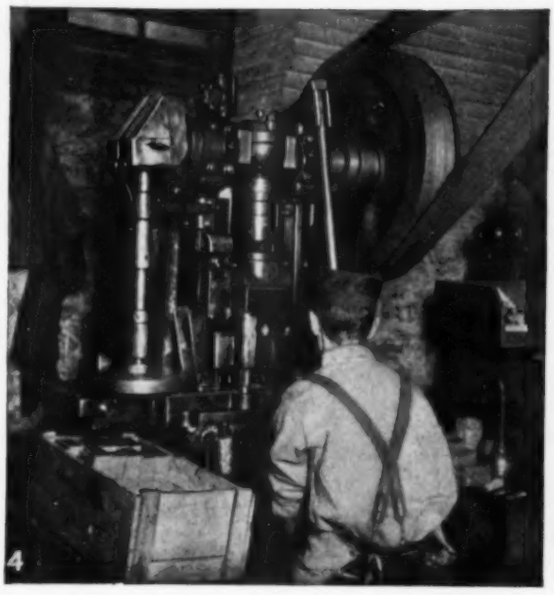
Fig. 1—Model H-1 Addressograph

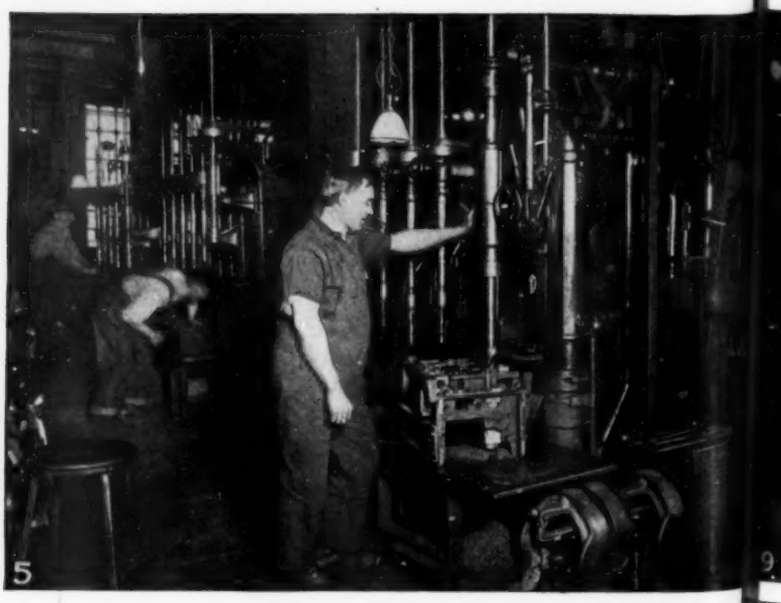
Fig. 2—Milwaukee milling machine working on hand-operated machine base

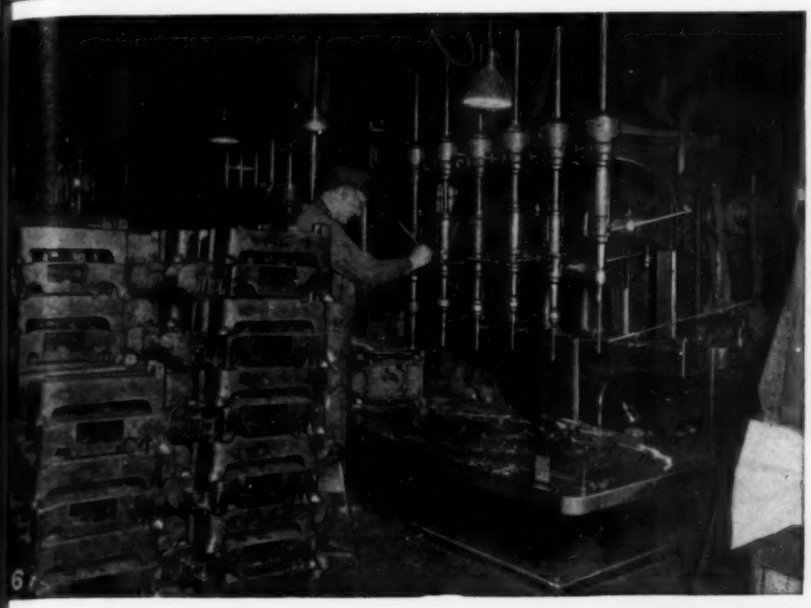
Fig. 3—Bevel gear blanks are made on the Brown & Sharpe automatic

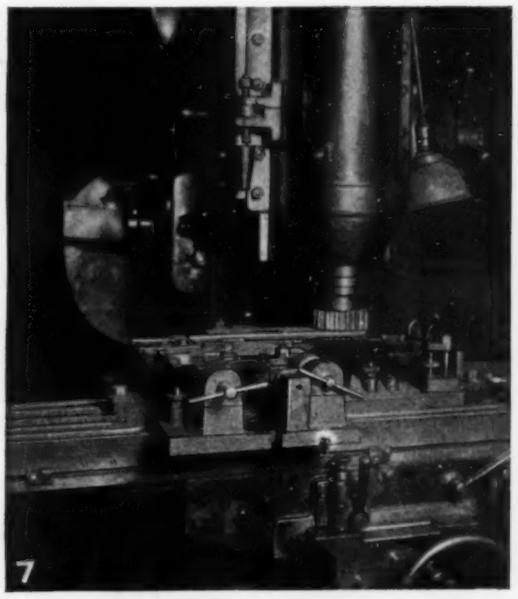
Fig. 4—Forming address plates. The vertical shaft geared to the crankshaft operates a stock-feeder

Fig. 5—Avey three-spindle and Barnes single-spindle drilling machines, in combination, drilling bases









to Save Office Work

Fig. 6—Hand-operated machine base is drilled on Avey six-spindle machine

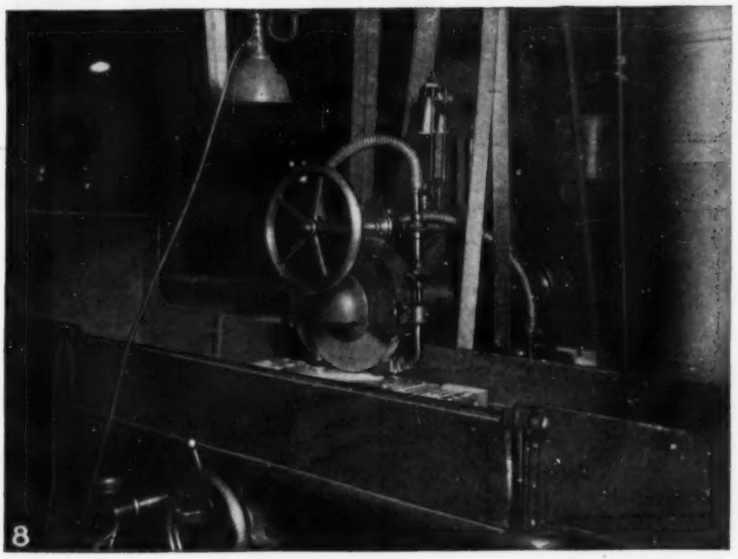
Fig. 7—Surface milling automatic machine base on Cincinnati vertical milling machine

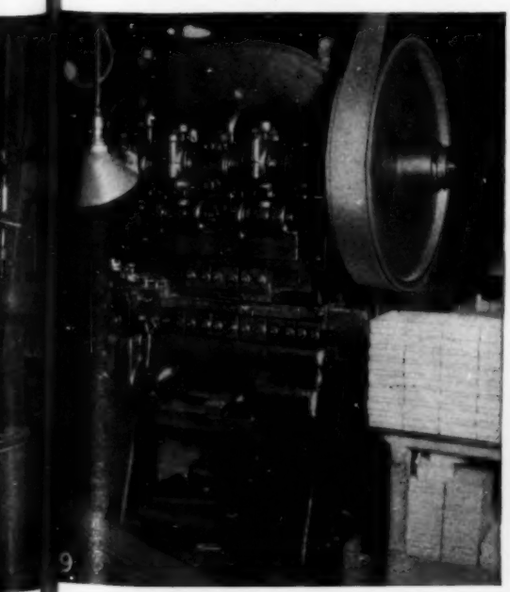
Fig. 8—Stop-bar surfaces ground on Diamond grinder, using Walker magnetic chuck

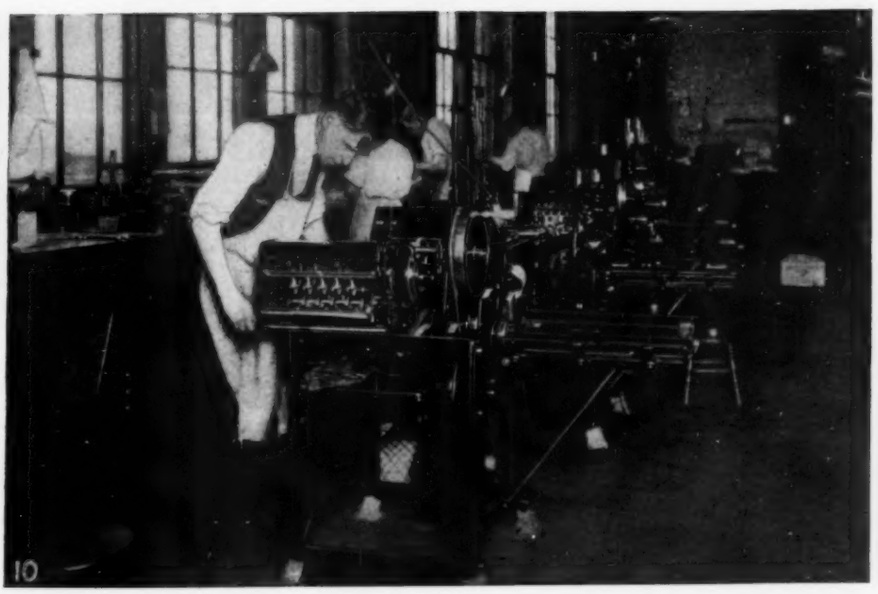
Fig. 9—One blanking and three forming operations on address plates at one stroke of the press

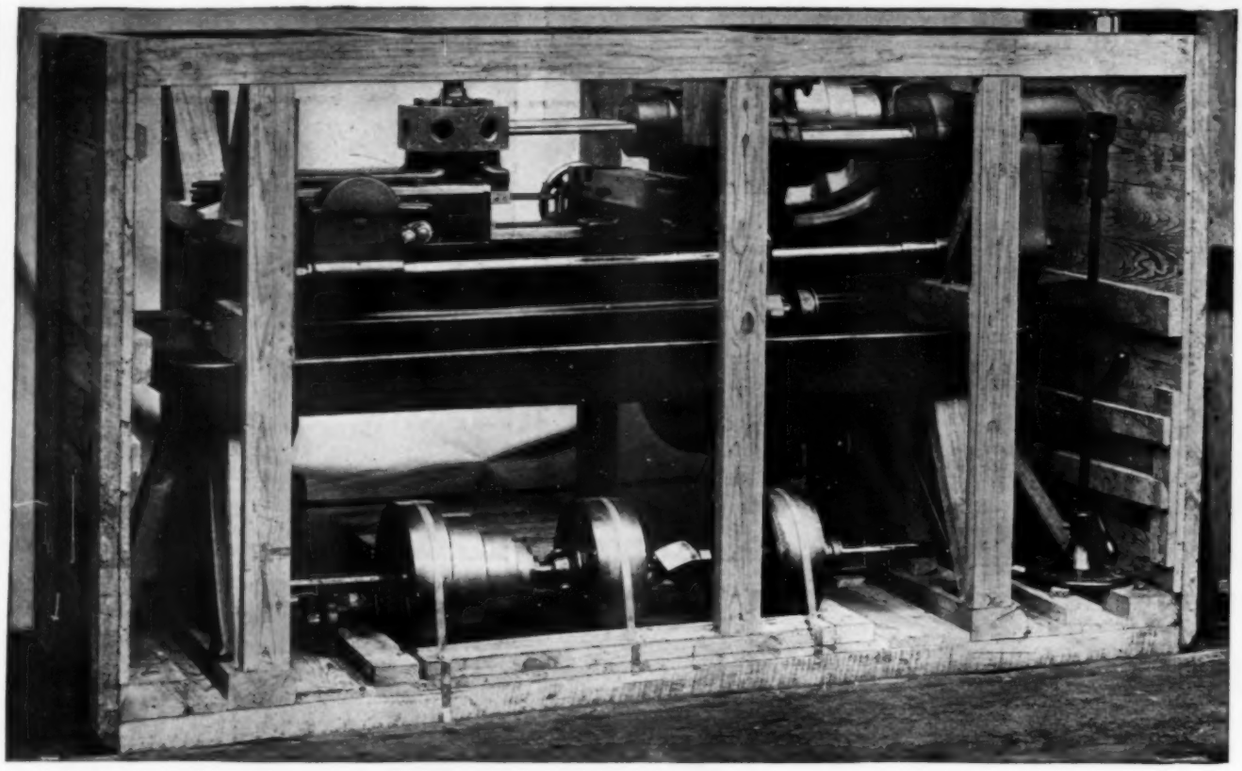
Fig. 10—Assembly department

Photographs by courtesy of the Addressograph Co., Chicago, Ill.





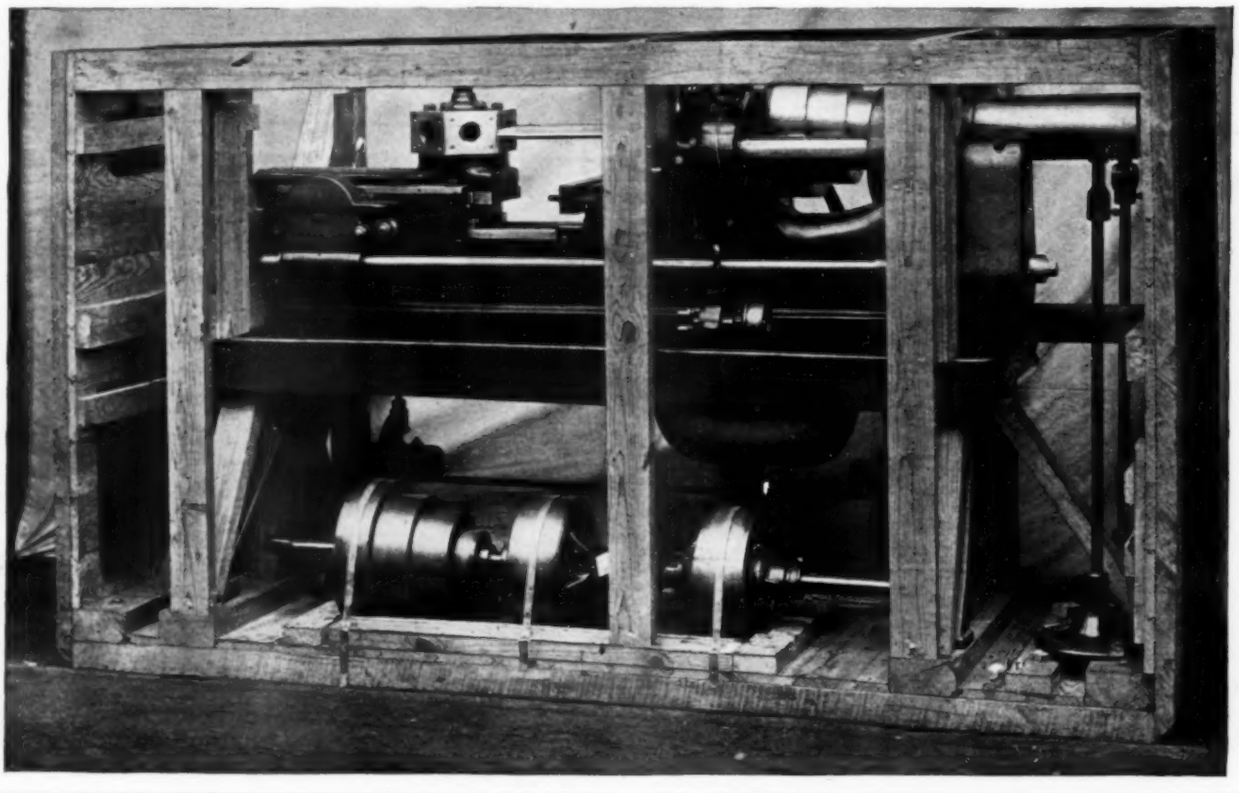




Screw Machine Packed for Export with Legs Intact

The legs are left on this machine on account of the pan bowl which projects below. This company has prepared blueprints showing standard crates and packing directions for all its machines. Note the heavy diagonal bracing.

Photographs by courtesy of the Acme Machine Tool Co.



Economic Analysis of Machine Shop Operation

By A. L. De Leeuw

Modification of method described where large quantities are involved—How much can be spent in special equipment for single operations—Cost of combined operations

THE question now is, to what extent, if at all, should this method be modified if the quantity is 10,000 (in one lot and no other lots expected). The total time for milling and set-up would be (100 × 50) + 25 = 5,025 min. As the cost per hour would be again 87½ cents, the total cost of this job would be $73.28. This amount is not enough to try to reduce it by a special fixture, for, whatever means of chucking may be provided, there will always remain the milling and set-up times which will amount to more than one-third of the total time, so that less than two-thirds of $73.28 can be saved.

If, however, the job should be recurrent, say, once a year, a special fixture might be considered provided there were a fair certainty that the job would last a number of years sufficient to allow the fixture to pay for itself.

Problem Different for Unlimited Production

An entirely different problem is presented when the quantity is unlimited or practically so. In this case savings are calculated not on a given quantity but on a year's production.

The productive part of the operation is the sawing. Chucking and manipulation of the machine are necessary but not productive as they interrupt the essential part of the operation, the cutting. As the cutting time is 10 sec. and the total time per piece 30 sec., it follows that the production could be tripled if the non-productive elements could be eliminated or if they could coincide with the cutting. This means that one piece must be cut while another is being chucked. The most perfect arrangement for obtaining this result is one by means of which the operation becomes continuous, such, for instance, as a rotating fixture, and any such device reaches its highest possible efficiency only when both operator and machine work all of the time. This should not be construed to mean that there shall be no rest for the operator or that he shall be driven, but that the work of man and machine shall harmonize. If the man must wait to allow the machine to finish its task, or if the machine must be slowed down to allow the man to perform his part of the work, then the highest possible efficiency of that combination has not been attained.

Testing the case under consideration by this principle and assuming the amount of time for chucking and cutting to be correct as given before, it is found that in order to cut continuously the feed must be in the direction of the axis of the small hole and not toward the center as heretofore.

As it is probably not possible to arrange the fixture so that the small ends of the connecting rods shall touch each other, the length of feed required per piece will be more than ⅝ in. Assuming that the distance between two adjacent pieces must be ⅝ in., the length of feed per piece becomes 1¼ in., so that now the time for cutting becomes 20 sec. instead of 10. This shows that there has been a loss in both elements of the operation. The cutting time has been increased from 10 to 20 sec. and the chucking time from 15 to 20 seconds.

The shape of the fixture will be that of a hollow cone, with the pieces of work chucked on the inside, so that that part of the connecting rod on which the work is done shall lie at the small diameter of the cone. The fact that the other end of the connecting rod is wider necessitates this arrangement. If the cut were taken on the large end this condition would have to be reversed, or else the fixture might take the form of a solid cone with the work chucked on the outside.

With such a fixture it will be possible to double up, using two hollow cones joined at their small diameter.

As a large part of the fixture is relatively far removed from the cutter, it will be possible to chuck two pieces with one manipulation of the clamping bolts, so that it should be possible to chuck two pieces in 20 sec. instead of one piece in 15 seconds.

Production Results With a Double Fixture

The following conditions now obtain: Two pieces are chucked in 20 sec. and two pieces are cut in 20 sec. by two cutters on one arbor—there is no idle time. As a result *one* piece will now be finished in 10 sec. instead of 30 sec. as before.

Under the first plan presented, that is, when a lot of 100 pieces had to be milled, the cost per hour was 87½ cents. An entire year's production at that rate would have cost 2,400 × 87½ = $2,100.

Apart from the cost due to special devices introduced in the last plan, the cost of a year's production will be again $2,100 but the value of the product will be three times as much or $6,300. It should be noted here that the term "value" does not mean the price charged to the public, but what one department of the shop would charge another.

Continued from page 809, Vol. 60, No. 22.

The additional value obtained permits the purchase of a certain amount of equipment needed for the new method. The amount itself is limited by a number of items, such as the factor f, the percentage p, and above all by the probable number of years the special equipment will be used. When this number is small the percentage p will be large, yet it cannot be said that p depends upon the number. This is only so when the percentage of depreciation has been increased beyond the normal.

The factor f gets new significance when special equipment or devices are used. When nothing but standard equipment is used, delays for repairs, etc., do not necessarily stop production as there is generally a duplicate tool or machine at hand. This is not so with special equipment, and an allowance expressed by this factor f should be made to cover contingencies.

Calculating the Amount That Can Be Spent for Special Equipment for Performing Single Operations

Considering these various items a formula can be constructed which will show the amount of money which may be spent for special equipment for the performance of *single* operations. Let

v = value of work in one year by old method
v_1 = value of work in one year by new method if production is uninterrupted
t = estimated number of years
$fv_1 - v$ = gain per year
P = amount to be spent for special equipment
p_1 = percentage of interest charge

Then $tp_1 \times P + P$ is total amount spent at end of t years, and this amount should be less than the amount of gain in that period.

$$tp_1 \times P + P < t(fv_1 - v)$$
$$P \times (tp_1 + 1) < t(fv_1 - v)$$

or

$$P < \frac{t(fv_1 - v)}{tp_1 + 1}$$

This formula applies when the equipment has no appreciable scrap value and cannot be used for some other standard operations.

If the estimated number of years of usefulness is so large that the regular factor of depreciation can be figured, then the formula becomes

$$pP < fv - v$$

or

$$P < \frac{fv - v}{p}$$

In the foregoing example the chucking time was assumed to be greater than the cutting time. Conditions are somewhat modified when the reverse is true. As an example, the drilling and spot facing of the two bolt holes will be considered. Various elements will be arbitrarily assumed as in the previous example.

Size of hole ..... ¾ in.
Drill speed ..... 70 ft. per min. (1,130 r.p.m.)
(For the sake of simplicity it is further assumed that a drill press with this speed is available.)
Feed per revolution ..... 0.006 in.
Feed per minute ..... 6.78 in.
Distance to drill ..... 1¾ in.
Time for drilling ..... 15 sec.
Time for chucking ..... 5 sec.

(The chucking time is assumed for a simple fixture, consisting of an angle plate, a stud for the large hole, a stud slightly flattened top and bottom for the small hole, and a single-jointed lever with cam hook for clamping.)

If a single drill were used the time for drilling two holes would be $15 + 15 + 5 = 35$ seconds.

If the cost of machine and floor space is $1,000, the wage per hour 75 cents, the time for set-up 25 min., and the quantity 100, then the cost per piece is calculated as follows:

Machine cost per hour	$0.0625
Wage cost per hour	0.75
Total cost per hour	$0.8125
Time for drilling 100 pieces	3,500 sec.
Time for set-up	1,500 sec.

Total time = 5,000 sec. = 83⅓ min.
Total cost = $1.13
C_u = 1.13 cents

Leaving for the present the spot facing and chamfering out of the problem, it may be well to see whether and when a two-spindle drill head will be economical. Assuming the cost of this device to be $100, the question is, how many holes must be drilled before this cost is absorbed.

On every piece a gain will be made of 15 sec., the money value of which is $\frac{15}{3{,}600} \times 81\frac{1}{3}$ cents. The number of pieces to be operated on to absorb $100 is therefore

$$\frac{100 \times 100}{81\frac{1}{3} \times \frac{15}{3{,}600}} = 30{,}000$$

If the two-spindle head is adjustable so that it can be used for other work as well, and if such work is available, it will be sufficient to absorb a proportionate part of the $100, and if such work is of regular recurrence so that the device becomes a part of regular shop equipment, a proportionate part of 15 per cent of $100 only must be absorbed.

In addition to drilling there is also spot facing and chamfering. The most common arrangement for performing such operations is a gang drill in which one spindle is used for drilling, one for spot facing, and one for chamfering.

Assuming the time required for spot facing to be 8 sec. and for chamfering 2 sec. with 2 sec. for each movement from spindle to spindle, the total time for the combined operation is found thus:

Chuck	5 sec.
Drill	15 "
Drill	15 "
Move to 2nd spindle	2 "
Spot face	8 "
Move to 3rd spindle	2 "
Chamfering	2 "
Move to 1st spindle	2 "
Total	51 sec.

The time for set-up also is increased, say, to 40 min., making the total time for 100 pieces

$5{,}100 + 2{,}400 = 7{,}500$ sec. = 125 min.

The cost per 100 pieces = $1.69, and
C_u = 1.69 cents

It remains to be investigated what can be done if practically unlimited quantities are to be worked up, and it should be noted that single operations are no longer being dealt with but a combination of operations, though of the simplest kind.

The longest cutting operation is 15 sec. and it would be a simple matter to arrange a number of spindles so that all operations were performed simultaneously in that time. This would require a multiple-spindle drill with six active spindles, two for drilling, two for spot facing, and two for chamfering. There would be four fixtures, three of them under the spindles and one one at the loading position. This arrangement involves an indexing table, which may be operated by hand. If the operation of indexing requires 2 sec., then a piece will be completed in 17 sec. instead of in 51 seconds.

However, this arrangement does not give the highest possible economy, for the machine is busy 15 sec. and the operator only 5 (in addition to the indexing). To keep the operator busy it will be necessary to have him load 3 pieces while the machine drills. This would mean that 18 spindles and 12 fixtures are required, while the table indexes to 4 positions. Under these conditions three pieces will be finished in $15 + 2 = 17$ seconds.

Under the conditions assumed for the small lot the cost of the operation was 81¼ cents per hour, or $1,950 per year. The output was one piece every 51 sec. while now it is three pieces every 17 sec., so that the output is nine times as large and therefore the value of a year's output has been increased by $8 \times \$1{,}950 = \$15{,}600$. If there is a fair degree of certainty that the article will be manufactured for two years then the total gain is $31,200, and any amount below this sum would be justified for special equipment. However, here again the factor f should be considered, and furthermore it should be kept in mind that there should be a large margin of profit in sight before such special equipment is purchased. On the other hand, such equipment as has been indicated here, is not necessarily strictly special; it may be standard—though not of general utility—so far as the machine is concerned and special in regard to fixtures. It should further be kept in mind that the output of such a plant would be very large indeed, and that it might not be kept fully occupied all the time.

With $f = 0.80$ the output would be

$$\frac{2{,}400 \times 3{,}600 \times 3}{17} \times \frac{80}{100} = 1{,}219{,}800 \text{ per year}$$

The piece under consideration would lead to many other similar problems and analyses. The two examples given are probably sufficient to indicate the manner in which the various factors which go to make for economy or lack of it should be viewed if one operation only is considered. Before proceeding with the study of the ultimate economy of the entire piece, the author wishes to call attention to the fact that no attempt has been made to exhaust all possible ways of accomplishing the results, and further, that the figures for feed, speed, chucking, time, etc., were assumed. Such items should be determined by actual observation and by analysis. The author merely attempted to show how factors, once determined, may be *co-ordinated* and combined.

The connecting rod under consideration is a drop forging. The rod and cap are forged in one piece, the sawing apart being one of the last operations. There are two holes to be produced with a rather high degree of accuracy, and there are further a number of minor operations such as drilling, tapping, facing, milling, and sawing.

There are two possible ways in which the cost of machinery may be reduced: by reducing the cost of the individual operations, and by combining operations. It is a comparatively simple matter to compare various methods and their costs when single operations are being analyzed. Quantity to be made, equipment on hand, and cost of equipment to be bought are controlling elements, taking it for granted that the necessary skill required for any method under consideration is available.

To analyze the effect of various combinations is a more complicated problem. At first glance it would appear as if an almost unlimited variety of combinations are possible, but a little study soon shows this not to be the case. Some combinations are not possible, others are clearly not practicable, and still others are so evident that they are hardly considered as combinations at all. If, for instance, a number of holes must be drilled in one surface of the work, it is so natural to do this on a multiple-spindle drill, or with a multiple-spindle drill head, if one is available, that it is hardly considered as a combination of individual operations. Similarly, if two parallel surfaces must be milled, it is but natural to use straddle mills, and this is not considered as a combination.

Operations may be combined for various reasons such as:

a To secure greater accuracy
b To avoid handling
c For the sake of economy.

Whatever is necessary to secure the required accuracy must be done, regardless of economy, so that this phase of the matter does not need to be considered. As to the second item, this is really a case of trying to economize. Overhead is saved sometimes even at the cost of direct labor. Where there is a saving in plain sight such combinations are resorted to, but such unmistakable cases are rare. It is generally somewhat difficult to estimate the cost of handling with even a fair degree of accuracy, while labor costs appear in plain figures. The third case, which really includes the second, is the problem with which this paper deals.

No general rule or formula can be given for guidance in an analysis of this kind, but it is possible to find the minimum labor cost if conditions are such that the ideal economy can be reached. In other words, it is always easy to establish an ideal to which we can work and from which we will depart only in so far as practical considerations compel us. Such practical considerations may be cost of equipment or perhaps the impossibility of combining certain operations, such, for instance, as planing and boring.

If the various operations to be done are denoted by 1, 2, 3, etc., and the times required are A_1, A_2, A_3, respectively, then the greatest possible economy will be reached if all of these operations are performed at the same time, and the time required will be A_m (that of the longest of all the individual operations).

It should be kept in mind that this refers to the labor cost only. The overhead incident to such a combination may, and often does, wipe out the saving in labor cost. Besides, the cases where it is practical to combine all of the operations are few and far apart. Nevertheless this ideal should be kept in view, and the

proper way is to ascertain to what extent it can be realized.

In the case under consideration we have the following individual operations:

Bore large hole
Ream large hole
Drill small hole
Ream small hole
Drill 2 bolt holes (really 2 operations)
Ream 2 bolt holes (really 2 operations)
Face top and bottom 2 bolt holes (really 4 operations)
Mill 2 sides of splasher (really 2 operations)
Drill 3 oil holes (really 3 operations)
Drill for binder bolt
Drill for tapped hole
Tap hole for binder bolt
Face hole for binder bolt
Saw small end
Countersink both sides large end (really 2 operations)
Countersink 3 oil holes (really 3 operations)
Saw cap from body.

There are then altogether 26 operations. It is assumed here that the two main holes are reamed, though they are often broached. This assumption is made so as to avoid unnecessary complications in the problem.

It is quite evident that the longest individual operation is either the drilling of the large hole or else the sawing of the cap from the body. A detailed analysis of these two operations would show that the drilling requires approximately 100 sec. while the milling can be done in about 30 seconds.

(To be concluded)

Looking Backward

By J. P. Poland

In an earlier letter I have told you how I happened to become acquainted with Mr. Tibbals, who had at one time conducted a cartridge factory in South Coventry, Conn., and who had sold out to the predecessors of the now great Union Metallic Cartridge Co. of Bridgeport.

At the beginning of the Civil War the cartridge shop in South Coventry was very busy when Mr. Tibbals received a communication from Gideon Wells, Secretary of War, wishing to know the capacity of the shop. Mr. Tibbals wrote in reply that he had all the work he could do and could not undertake Government contracts; whereupon Mr. Wells informed him that if he would not accept Government contracts "he would take the shop away from him and run it himself." "At that," said Mr. Tibbals, "I made up my mind that I had better work for the Government," so all through the war he ran the shop on government orders and under government inspection.

Mr. Tibbals made cartridges for all the different pistol and rifle manufacturers then doing business. I remember his telling us of going to Boston to see about a large order for ammunition for the Sharpe's rifle, which was then made in a shop way out Tremont Street on the open meadows; a shop that was afterward the Chickering piano factory.

Some of the first troops in the civil war to be equipped with the Sharpe's rifle were in an engagement with the Confederate soldiers, and, after the first volley from the Union ranks, the Confederates, as was their usual custom, charged immediately; only to be met with another volley. "What kind of guns," said a captured Confederate soldier, "do you Yanks carry, that you can load them up on Sunday and shoot all the rest of the week?"

Many of the tools, jigs, etc., used in the South Coventry cartridge factory were very ingenious, and the men, boys and girls operating them attained great expertness. I remember one device, told of by Mr. Tibbals, for covering the fulminate in the caps with varnish to hold, protect and water-proof it. A board was drilled with holes, each of the right size and depth to hold a cap, a handful of the copper caps was spread upon it and with a few deft movements of her hand a girl swept the caps into the holes until all were filled. Another board had set in it a series of needles in position to correspond to the holes in the first board. The needles would be dipped into a pan of varnish and when withdrawn each needle would have, clinging to its point, a drop of varnish. The board of needles would then be placed over the board of caps, being guided by dowels to the correct position so that each needle would enter a cap and, touching the fulminate, deposit a drop of varnish upon it. The varnish would immediately spread over the fulminate and the sides of the cap, completely sealing it against moisture.

Handling a Dangerous Explosive

Fulminate is very dangerous stuff to handle, as it can be exploded by a jar, and the man who made it worked by himself in a small building at some distance from the others. Mr. Tibbals had often warned this man of the dangerous nature of the compound, but as he became accustomed to the work he probably got somewhat careless, for one day there was a loud explosion and when the people ran out to see what was the matter there was nothing to be found of either man or building.

After Schuyler, Hartley & Graham bought out the South Coventry cartridge plant Mr. Tibbals invented and patented a reinforcement for the base of cartridges. It was simply an additional piece of copper or brass forced into the shell to prevent the hammer, upon striking, from cutting through and allowing the powder to blow back into the shooter's face. This was a valuable improvement, as the shell could then be made of thinner and less expensive material. Schuyler, Hartley & Graham were having hard sledding at first, and they told Mr. Tibbals that unless they could get that patent they would be obliged to close their shop. To prove his generosity Mr. Tibbals sold it to them for four hundred dollars; which was but a fraction of its value.

Charter Oak Avenue in Hartford ran eastward from Wethersfield Avenue (now Main St.) nearly to the Colt factories. As you descend the hill toward the Connecticut River there is on the right a beautiful church, built by the Colonel's widow, and over one of the large windows facing the Avenue you may see, sculptured in the brown sandstone, all the different parts of a revolver; surely a strange device with which to decorate a church. When I lived in Hartford it was known as "the Church of the Holy Revolver."

Colt's armory, during the life of Colonel Colt, was a very busy place. When I worked there most of the "west" armory was not used by the Colts but was leased to various manufacturing enterprises; the armory occupying the eastern section along the river front. Like many other Hartford shops, the "Armory" had bred a number of excellent mechanics who later attained high rank in other positions.

Albuquerque Shops of the Santa Fé

By Howard Campbell
Western Editor, *American Machinist*

Scientific tool grinding by an expert—Equipment for tire and axle jobs—Special tool for turning crankpins —Grinding on a production basis—Brazing equipment

ALL LATHE, planer and other single point tools are ground by one man, using a Gisholt tool-grinding machine for the job. A chart showing the correct angles to which the tools should be ground is supplied for the use of the operator and a case in which is displayed a complete assortment of lathe and planer tools that have been ground according to specifications is located within easy reach of the operator, as shown in Fig. 9. Clearance and side rake gages, similar to those shown in Fig. 10, are also supplied to assist in obtaining the correct angles.

At least three (and in many cases more) sets of tools are made up for each machine throughout the shop, so that one set can be in use while the others are being ground. The tools are gathered from the machines at regular intervals, a newly-ground set being left in place of those taken to the tool grinder. As

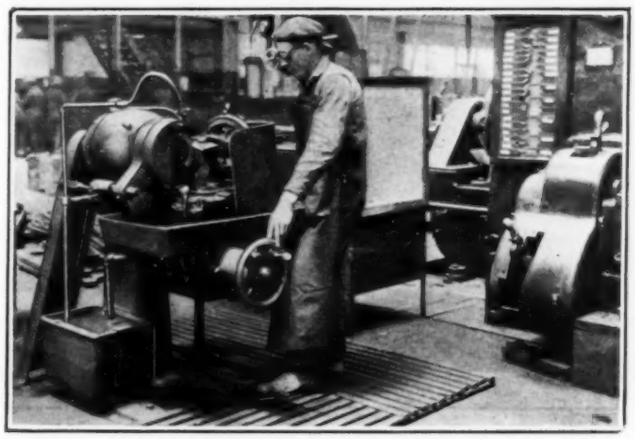


Fig. 9—All single-point tools are ground here. Note case of correctly ground tools

fast as the tools are ground they are placed in the cupboard shown in Fig. 11. This cupboard is kept locked and is only accessible to the grinding machine operator and the tool-runner, so that an accurate check can be kept on tools. Tools that are badly worn are laid aside and taken to the blacksmith twice a day for reforging. The blacksmith is also supplied with a set of gages so that excessive stock will not be left for the grinder. All bar stock and tubing is cut to length on the Q. M. S. cold metal saw shown in the illustration Fig. 12. This machine is manufactured by the Hanna Engineering Works, Chicago, Ill.

Concluded from page 801, Vol. 60, No. 22.

Driving wheels, tires and cylinder bushings are machined on the Niles boring mill shown in Fig. 13. The drivers are cast with approximately 1 in. of stock in the hole, 1 in. on the periphery and $\frac{1}{2}$ in. on the face, to be machined off. The tool used for the operation shown is of 2x3-in. high speed steel. Another example of the class of equipment used is the Putnam axle lathe shown in Fig. 14. The axle is held by dead centers

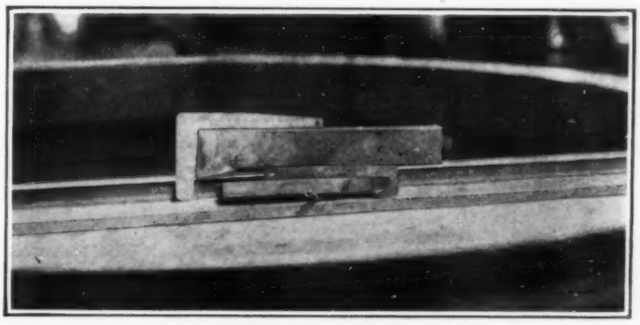


Fig. 10—Clearance gages for tools

at both ends and is driven by lugs on the revolving drum in the center of the machine, the lugs engaging and driving a double-end dog on the axle. The ends are turned simultaneously, using 1x2-in. high speed tools for the job. Running at a speed of 27 r.p.m., and with a $\frac{3}{32}$-in. feed, a cut 1 in. deep can be taken. The usual time for turning out an axle is one hour.

A Niles quartering machine is shown in operation in Fig. 15, boring the holes for the crankpins in a pair of driving wheels. Both holes are bored at the same time, producing a good and accurate job in a minimum amount of time.

The illustration Fig. 16 shows one of the special tools that have been made to cut down production time and reduce costs. This is a tool for recessing the front wheel for the crankpin shoulder, the dimensions of the recess being 11x14$\frac{1}{2}$x$\frac{3}{8}$ in. The job is done on a Pawling & Harnischfeger horizontal boring machine, the tool being attached to the spindle of the machine as shown. The tool is located in a rest gibbed to a slide that is fed by means of a handle on the end of a feed screw. The tool revolves at a speed of 19 r.p.m., taking a $\frac{1}{8}$-in. cut at a feed of $\frac{1}{32}$ in. per rev. A star feed will be applied to the tool as soon as it can be made.

Another special tool that is used on the P. & H. horizontal boring machine is the crankpin turning tool shown in Fig. 17. The body of the tool is a section of

Fig. 11—Surplus sets of ground tools are kept on hand

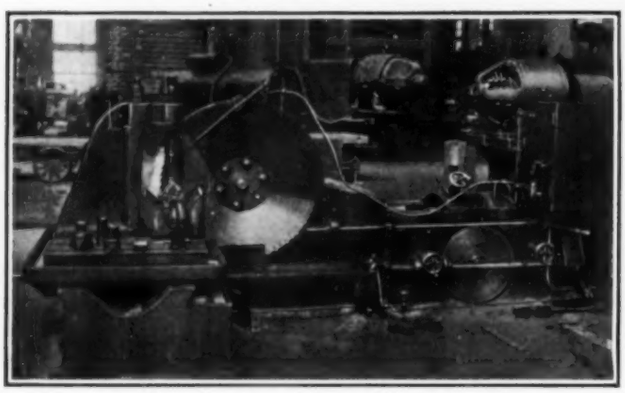


Fig. 12—Q. M. S. cold metal saw

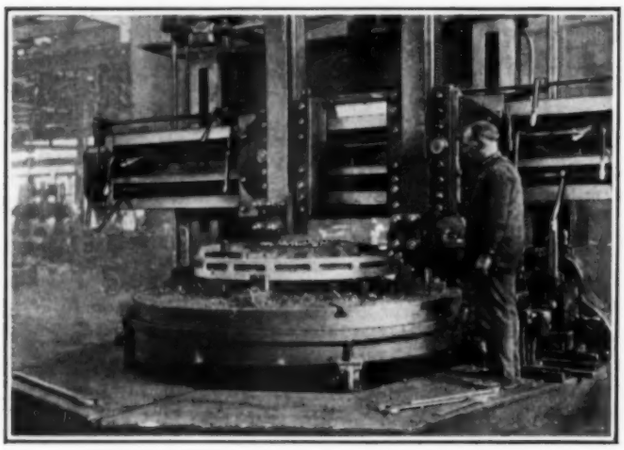


Fig. 13—Machining driving wheels

steel tubing into one end of which a solid piece has been pressed and anchored, the piece also forming a shank that is anchored to the spindle of the machine A band on the outer end of the tubing carries the tool, as shown at *A*, the sleeve sliding through the support *B* as it feeds on to the pin. When just enough stock is taken off the pin to "clean up," a speed of 19 r.p.m. is used with an 0.0084-in. feed. A pair of pins of the largest size can be turned with this tool in approximately 5½ hours, smaller pins requiring less time.

A job of making steel bushings is shown in operation in Fig. 18. The machine is an 18-in. American engine lathe with a turret attachment, having an automatic feeding device that is attached to the rear of the lathe as shown in the illustration. An extra tool rest is attached to the rear end of the cross slide to hold the

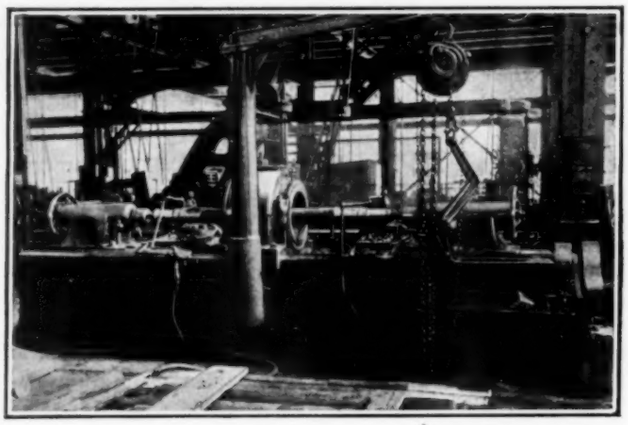


Fig. 14—Turning both ends of axle simultaneously

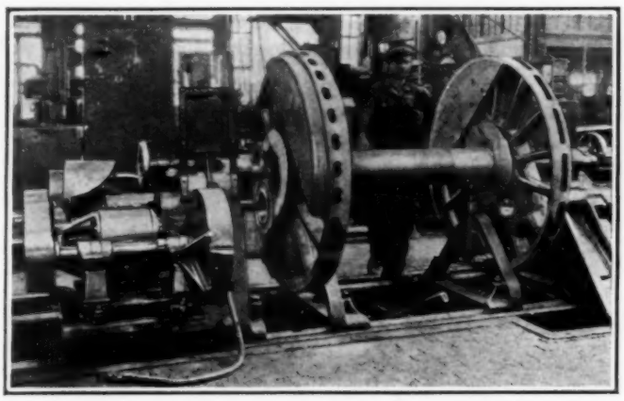


Fig. 15—Boring holes for crankpins

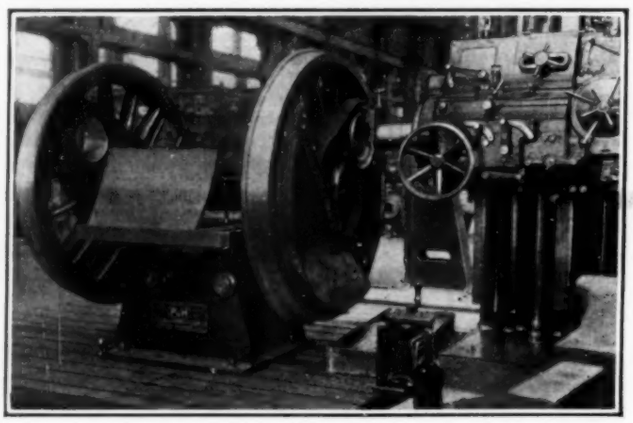


Fig. 16—Recessing front wheel for crankpin shoulder

cutting-off tool, so that the tools will not have to be changed, thus reducing the time on the job considerably.

One of the most important machines in the shop is the Diamond grinder illustrated in Fig. 19. The job shown is that of grinding stock for shear-keys for main and side rod straps. Ten pieces are ground at a time, a D. & W. Fuse Co., magnetic chuck being used to hold the work. The pieces are forged and $\frac{1}{16}$ in. of stock is left for grinding. The wheel is a 14-M Morton segment wheel, running at a speed of 1,200 to 1,400 r.p.m. All four sides of the pieces are finished,

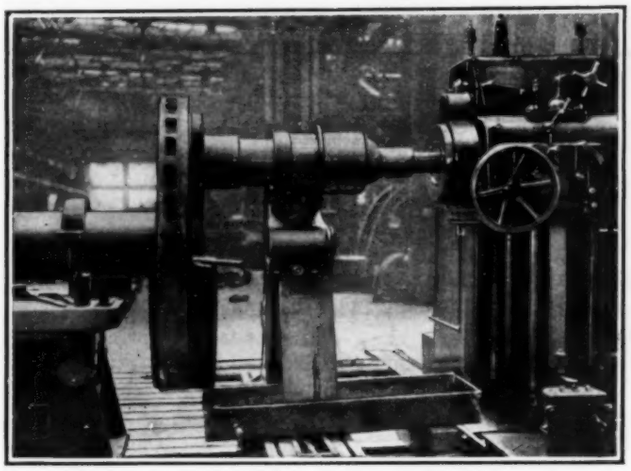


Fig. 17—Special crankpin turning tool

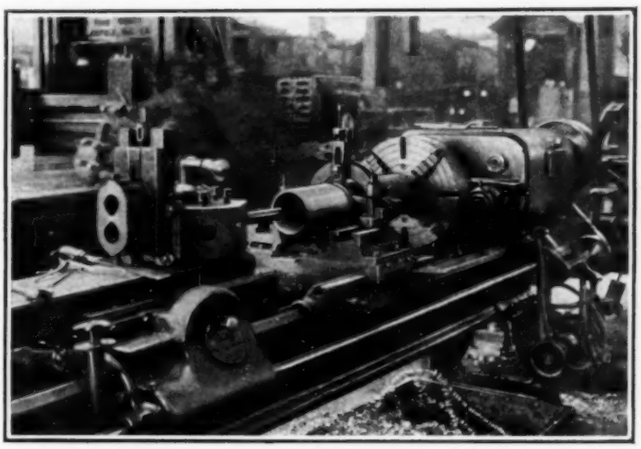


Fig. 18—Making steel bushings

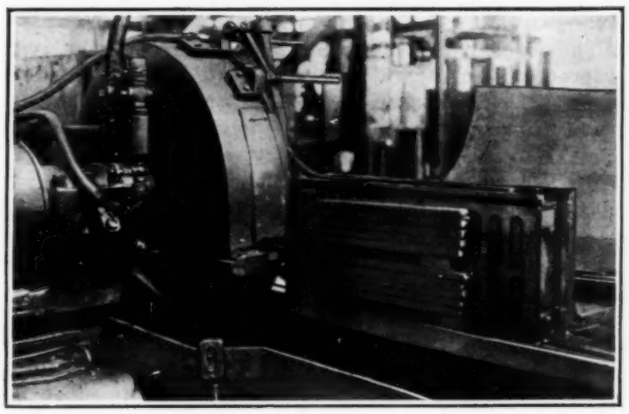


Fig. 19—Grinding stock for shear keys

Fig. 20—This device holds pipes in a convenient position for brazing

Fig. 21—Tire-heating pit

the dimensions being held to approximately 0.010 in., and the ten pieces can be ground in an hour. This machine is also used for grinding cross-head and crankpin collars. The collars are made out of boiler plate and just enough is ground off to clean up the surface. Eight pieces are held on the chuck at a time and both sides of the eight pieces can be ground in approximately 30 minutes.

A handy device to hold copper pipes while they are being brazed is shown in Fig. 20. This consists of a section of pipe with cross-arms and clamps made to fit the various kinds of pipes that have to be brazed, the whole being anchored to the floor in a vertical position as shown. A tray is clamped to the standard to hold all the necessary materials where they will be available to the operator. The device holds the work in such a position that it can be approached from all sides, adding to the convenience of doing the job and thus expediting the work.

A pit in which tires are heated to expand them so

that they can be shrunk on to the wheel centers can be seen in the illustration Fig. 21. The pit is built of ½-in. sheet steel, lined with a two-foot wall of fire brick. The pit is 6 ft. 9 in. deep, is 8 ft. in diameter inside the wall and protrudes 36 in. above the floor with the cover on. A flange at the top of the pit provides a rest for the cover, which is 12 ft. in dia., and 12 in. high. The three burners, which are made in the Topeka, Kan., shops of the Santa Fe Ry., are placed at the bottom of the pit in such position that the flames will encircle the tires. Crude oil is used for fuel. The capacity of the pit is ten tires or five sets per heat, and the time required for heating is from 15 to 18 minutes.

Famous Machinists of History

By H. H. Manchester

James Brindley (1716-1772)

JAMES BRINDLEY was born in Derbyshire, England in 1716. His father was a humble cottager who much preferred going many miles to a "bull running" to working his own little place. His mother was industrious, but could give him but little education, and in fact to the end of his life James wrote a hand that was scarcely legible, and spelled his words as they were pronounced in the Derbyshire dialect.

James Brindley

There was, however, a grist mill not far from his home, and as a boy James used to go to the mill to study the construction of the water wheels and cog wheels, then to return home and construct models of them in wood.

Because he showed such mechanical taste, at the age of seventeen he was apprenticed for seven years to Abraham Bennett, a millwright near Macclesfield. At that time it may be remembered the millrights were almost civil engineers. They were expected to be able to lay out a mill dam and sluice, construct any sort of a mill, and at least repair any machinery in it.

Bennett himself frequented the taverns, and much of James' first year at the shop was spent in running for ale for the men. He learned slowly, and like many another apprentice was made the butt of the workmen. But in spite of his utter lack of education, he thought clearly, and gradually acquired a more thorough knowledge of the principles of the machinery than the other men.

One job which Bennett reecived was to repair machinery in a silk mill. This was complicated, and Bennett and his men got started wrong. Word was going the rounds that they had fallen down on the job when Brindley heard of it. He went out to the mill on Sunday and discovered what was wrong. Monday morning when Bennett and his men came to work they found Brindley busy on the job, and the worst difficulties already straightened out. From that time on Brindley became known as a skillful machinist, able to construct or repair practically any machinery and particularly quick to see chances for improvement.

Soon after Bennett's death, Brindley set up for himself as a millwright at Leek, and soon acquired a wide reputation.

In 1752 he designed machinery for draining coal pits at Clifton, and three years later completed the machinery for a silk mill at Congleton.

In 1759 he built a canal for the Duke of Bridgewater from Worsley to Manchester, carrying it by an aqueduct over the river Irwell. This was a great success, and Brindley was soon busy with the construction of the Grand Trunk and other canals.

The importance of these before the development of the railroad can now scarcely be realized. At one time Brindley stated that the principal use of the rivers of England was to feed canals. They occupied much the same position then as ship canals in the same location would today.

Brindley died in 1772, at the comparatively early age of fifty-six, but he was already recognized as one of the pioneer engineers of England.

Checking Drawings

By John Mark May

The method of checking drawings recommended in the article on "Tool Engineering," page 463, Vol. 60, of the *American Machinist*, has, in the writer's opinion, every point in its favor that was mentioned. But is there not one other way that has additional points in its favor?

This other way is to make a blueprint from the tracing before any checking is done and make all corrections, changes and notes on this print. While the corrections can be made with a soft black pencil, a white, yellow or red one will show more distinctly. Among the advantages of this method are the following:

The checker does no marking on the tracing, not even reference numbers or marks of any kind that afterwards have to be erased. The blueprint can be kept, if necessary, for future reference as it shows clearly all changes that have been made.

With other methods there is always an uncertainty in the checker's mind, when the drawing comes back to him for his final O.K. and signature, whether all changes have been made in accordance with his corrections, as those that he marked on the tracing have been erased and it is not uncommon for him to feel that it is necessary to go over his computations again. This of course is not required when the blueprint containing his corrections is available. The cost of the blueprint is the only added expense and it is much more than offset by time saved by both tracer and checker.

Machine Tools—The European Market

By W. H. Rastall
Chief of Industrial Machinery Division, Bureau of Foreign and Domestic Commerce

Our business with Europe, Canada and Latin-America expanded during the year 1923—Asiatic business decreased—Conditions in Europe are changing—Improved business will probably develop

THE machine tool industry has always found the markets of Europe very important to its export trade. Before the war the European markets absorbed by far the greatest part of our exports of metal working machinery, and also were the markets in which it was found possible to sell the more specialized and higher types of such machinery. During the war the volume of sales expanded very greatly and most of our manufacturers were able to secure very attractive business. In the pre-war period Germany was our best foreign customer for such machinery, absorbing more than $2,250,000 worth per year; England ranked next and absorbed over $2,000,000 worth annually. During the war the trade with Germany collapsed but the trade with England expanded greatly, growing to nearly $20,000,000 a year, and the trade with France went to nearly $30,000,000 per year. With the collapse of the post-armistice boom this trade has fallen off seriously.

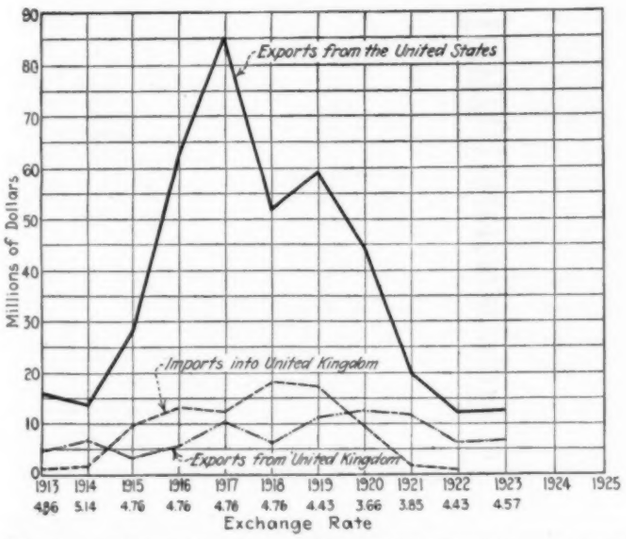

Millions of Dollars
Exports from the United States
Imports into United Kingdom
Exports from United Kingdom
1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925
4.86 5.14 4.76 4.76 4.76 4.76 4.43 3.66 3.85 4.43 4.57
Exchange Rate

Chart 1—Exports of metal-working machinery from the United States and the United Kingdom and imports of metal-working machinery into the United Kingdom from the United States

At the risk of repeating material that has already been called to your attention, Chart 1 is presented, giving the history of this trade which you will remember rose from a pre-war level of about $15,000,000 per year to a maximum in 1917 of $85,000,000, and in 1922 and 1923 approximated $12,000,000. The diagram shows that the export trade in metal-working machinery is even smaller than before the war and has apparently settled down to a minimum value of about $12,000,000 per year.

However, some very interesting facts are revealed by a further comparison of the detailed returns for 1923 and those of 1922.

Decreased Volume of Trade with Asia

The most significant fact revealed is the decreased volume of our trade with Asia, which has shrunk from about $4,300,000 to about $2,300,000, declining from 35 per cent of the total business to only 18 per cent of the total. But it is encouraging to note that Asia is the only great group of markets that has shown a smaller volume of business in 1923 than in 1922, the business to Europe expanding from $3,900,000 to $4,800,000, that with Canada from $1,600,000 to $2,900,000, and the trade with Latin America from $1,600,000 to approximately $2,000,000, the increase being mostly in Mexico, Central America, and the Caribbean countries.

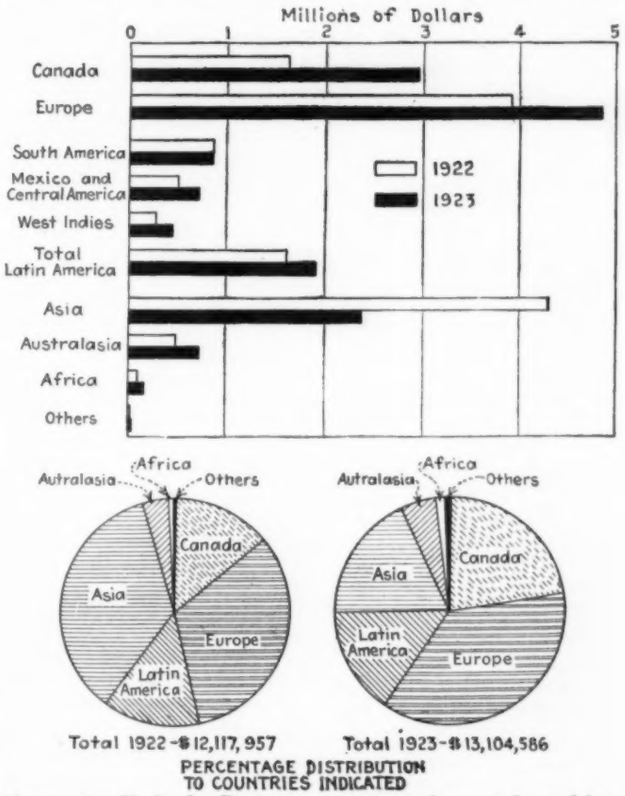


Chart 2—United States exports of metal-working machinery (by continental groups) 1922 and 1923

Delivered before the National Machine Tool Builders Association, May 22.

In Table I and Chart 2 these returns are shown more fully.

However, these matters should not be emphasized too strongly because one might draw unfortunate conclusions from the above sweeping generalities. More

Table I—United States Exports of Metal-Working Machinery (by Continental Groups)

Destination	Calendar Years 1922	1923
Canada, Newfoundland, etc.	$1,634,675	$2,965,016
Europe (except Balkans)	3,914,067	4,853,729
South America	857,377	852,927
Mexico and Central America	505,570	706,508
West Indies	284,483	433,114
Total Latin America	1,647,430	1,992,549
Asia (except Asia Minor)	4,325,974	2,386,220
Australasia	482,956	725,695
Africa	93,279	158,982
Other countries	19,576	22,395
Grand Total	$12,117,957	$13,104,586
Percentage to—	Per Cent	Per Cent
Latin America	13.6	15.2
Asia	35.7	18.2
Canada, Newfoundland, etc.	13.4	22.6
Europe	32.3	37.0
Australasia	4.0	5.6
Africa	0.8	1.2
Other	0.2	0.2

detailed information is given in Table II and Chart 3. They draw attention, first, to the serious decrease in the volume of our business with British India, China, Brazil, Chile, Colombia, Venezuela, the Philippines, and Trinidad. In each case it would probably be reasonably easy to explain why these changes occurred, but

Table II—United States Exports of Metal-Working Machinery for 1922 and 1923

Country	Rank	1923	Rank	1922
Canada	1	$2,956,589	3	$1,630,584
United Kingdom	2	2,451,499	2	2,133,440
Japan	3	1,484,618	4	1,469,394
France	4	1,091,967	5	1,021,942
British India	5	717,757	1	2,404,384
Australia	6	638,618	7	413,542
Mexico	7	585,728	6	446,920
Cuba	8	382,640	9	236,724
Spain	9	280,350	11	228,815
Belgium	10	220,680	13	160,221
Germany	11	209,474	17	77,120
Argentina	12	204,321	14	158,090
Brazil	13	199,889	10	233,891
Chile	14	187,977	12	200,001
Italy	15	142,263	15	82,157
British South Africa	16	139,353	21	61,234
Netherlands	17	123,859	23	52,562
Sweden	18	111,591	24	30,832
New Zealand	19	85,962	20	69,455
Peru	20	79,011	18	73,636
China	21	76,095	8	319,131
Colombia	22	66,617	16	77,676
Venezuela	23	63,011	19	70,407
Philippine Islands	24	44,968	22	57,503
Honduras	25	38,935	25	24,150
Panama	26	26,972	28	10,100
Dutch East Indies	27	22,553	27	14,471
Dominican Republic	28	16,717	29	8,747
Trinidad and Tobago	29	6,961	26	17,264
Rumania	30	4,266	30	5,688
Egypt	31	2,727	31	3,984
Total all countries		$13,104,586		$12,117,957

the decrease in the volume of trade with these various countries should not be allowed to obscure the pleasing increases found elsewhere, as, for example, with Canada, the United Kingdom, Germany, Belgium, Spain, Italy, Holland, Sweden, for Europe, and Mexico, Cuba, Argentina, and possibly certain other countries in South America.

Conditions in Europe Changing

A study of this table and chart suggests immediately that conditions in Europe are changing. It is probably most significant that the trade with Germany is developing, while among the allied powers it will also be noted that there has been an important increase in business. These figures, when considered in connection with the changes in the business situation in Europe during recent months, suggest that our business there

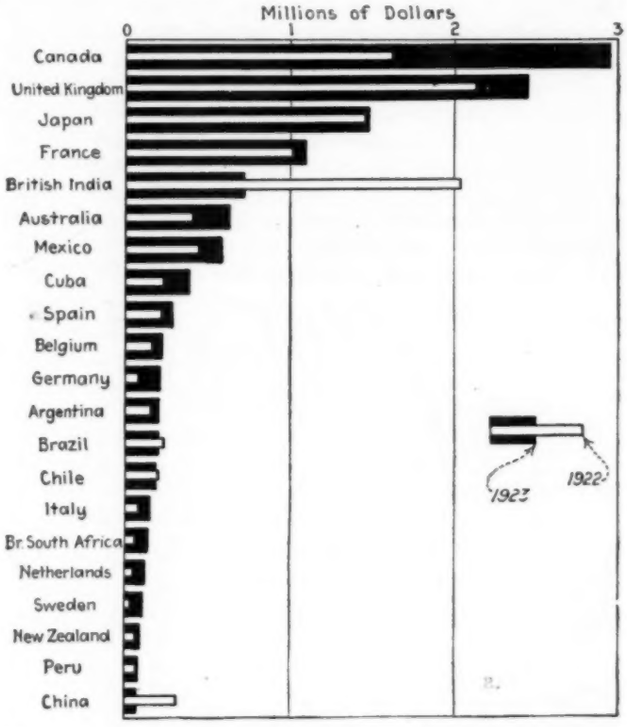


Chart 3—United States exports of metal-working machinery, 1922 and 1923

is reviving, and that we can expect European industry to demand from American manufacturers machinery as needed for its operations.

The situation as described in general by these figures has also been confirmed to the Bureau of Foreign and Domestic Commerce by reports received from many European countries. The exchange situation has improved greatly during the last twelve months. It is possible that some sort of solution for the various reparations and other problems in Europe will be worked out in the near future, and if a condition of stability is reached for Germany and probably some of the other countries of Europe, a greatly improved business situation will probably develop. Although conditions in Asia at the moment scarcely encourage active sales work there, it would appear that the markets of Latin America are expanding, and for the immediate future the markets of Europe deserve particularly careful study.

Costs and a Cost System

By H. P. Dix
Secretary and General Manager
Wilmarth & Morman Co.

How to determine what the list price should be — What records are necessary in a cost system—Information that can be used by any maker of machinery

WE HEAR a lot about costs and cost systems. Efficiency engineers come to our plant and impress upon us the importance of accurate costs. Not long ago I heard one of our best known economists say, "No manufacturing plant can exist today unless the management knows its costs and the plant is conducted upon a budget system." The General Manager of this association, Mr. DuBrul, has visited a large proportion of the plants owned by the members. He has come to some very definite conclusions as a result of his investigation and study, the most outstanding of which is that the individual members of this association *must* give this subject of costs serious consideration.

Machine tools are manufactured upon a high competitive basis and marketed for the most part through dealers, at a fixed list price to the user. It is, therefore, the establishment of this list price that determines success or failure to the manufacturer. There are but two ways to arrive at the list price: first, to maintain accurate costs in your plant, and second, to make your list prices a little higher or a little lower than those of your competitors. Not more than six months ago I was talking to the general manager of one of our machine-tool plants about costs. He told me that several months previously he had changed his prices, and that as was his usual custom when the new price sheets were printed, he sent a set of each to his competitors, with no comment , simply mailing them as such.

A few weeks after they had gone out, he received this letter:

"Gentlemen:

We acknowledge receipt of your revised price lists of blank date, for which we thank you. Enclosed herewith please find copy of our revised price lists of blank date. You will note that some of our list prices are slightly lower and some slightly higher. We did not deem it advisable to make them all the same."

It does not require much thought to know what kind of a cost system the writer of this letter maintained in his plant. Now the method mentioned above might be all right if the manufacturing conditions were identical, or I might even say similar in the two plants, but as is more often than not the case in the machine tool industry, manufacturing conditions vary most widely. One plant may make one type of machine only, not varying greatly in weight or multiplicity of parts, whereas another plant may manufacture several distinct types with wide variations of weight and intricacy of parts, and the actual cost of building the same type of machine in each of these plants will most assuredly not be identical.

Delivered before the National Machine Tool Builders' Association May 23.

It is not necessary to employ a large and constant force in the maintenance of costs in the production department. Too many branches of the average production department are in a rut, and are simply accumulating figures that are not looked at. The head of that department is perhaps afraid to dispense with these figures because he fears they will have some bearing on some other figures that he knows nothing about, figures or data that might be accumulated and recorded in the management's office. Therefore he himself is in a rut and continues day in and day out to keep several operators working comptometers and adding machines, merely to accumulate masses of figures, which for the most part are filed away and never even referred to. The manager himself does not take the time to go to the production department and investigate the real use of accumulated figures and data. Should he decide to investigate this accumulation of data in the cost department, he will be afraid to dispense with any of the movements of that department for fear some day he or they might want these figures.

DEPARTMENT	HOURS PER DEPT.	AVERAGE RATE PRODUCTIVE LABOR	TOTAL PRODUCTIVE LABOR	DEPARTMENT OVERHEAD	TOTAL OVERHEAD
1	2	3	4	5	6
C	20	$ 0.50	$ 10.00	$ 0.24	$ 4.80
P	30	0.60	18.00	0.80	24.00
D	20	0.55	11.00	0.50	10.00
M	40	0.60	24.00	0.60	24.00
A	100	0.60	60.00	0.20	20.00
			$123.00		$82.80
					123.00
Factory cost (less material)					$205.80
1000 lb. gray iron @ 6¢ lb.				$ 60.00	
100 lb. cold rolled steel @ 4¢ lb.				4.00	
20 lb. bronze @ 30¢ lb.				6.00	
					70.00
Miscellaneous material purchased					30.00
Factory cost					$ 305.80
Add per cent selling expense; per cent for profit and safety					

Method of computing list price

Now, in the majority of cases, the reason that these data are being accumulated is because some efficiency engineer, employed at some time to put in the system, thought that they should be accumulated, recorded and filed, and he may have had very good reasons for so directing. Possibly the efficiency engineer was too ambitious, and so has your cost department accumulating data for no purpose, but more possibly these data are valuable for what I term periodic check-ups. You know it is a good thing for any of us to go to Battle Creek (or a similar sanitarium) periodically, say once in

five years, to get a general checking up, to test our ability to do this or that. By thorough examination we learn what we are capable of doing and what we are not capable of doing, and more important, what we should do and what we should not do to develop and preserve our strength and energy. That is a periodic check-up. Now, in the same way, I believe it is well for us to periodically increase the force of our cost or production department, and for the necessary period re-establish our overhead rate, delve into our costs, and, in brief, find out exactly what we are doing and what we are capable of doing. After this work has been completed to our satisfaction, let out the whole cost department, retaining only sufficient force to maintain the actual necessary records.

The four important points that a cost system must cover are:

1. Records that will maintain a perpetual inventory of raw and finished materials.
2. Records that will check your employees' time against time clock cards or record of attendance.
3. A carefully laid out budget and simple records to show that each department is operating within the limits set by this budget. They should also establish department rate or so-called department overhead.
4. Records that will give you a true factory cost of your product and route the work through the shop.

Taking point No. 1, namely, records that will maintain a perpetual inventory of raw and finished materials, we will all appreciate the value of perpetual inventory cards, from the standpoint of the purchasing department, the management and the shop management. The perpetual inventory cards, and I am not speaking of the stock-room cards, should show:

1. Where the material was purchased.
2. Price paid for the material.
3. Order number.
4. Time to deliver.
5. Quantity purchased.
6. How often purchased.
7. Quantity on hand.
8. Parts reserved against orders in production in shop.
9. Sizes of lots to manufacture.
10. Maximum and minimum stock.

To maintain and keep up-to-date the perpetual inventory card of raw and finished material, and parts manufactured in the plant, the system should include the "master sheet method" of laying out given quantities of machine tools to be manufactured in the plant. The master sheet lists all the manufactured parts and parts purchased that go to make up the finished machine tool, ready to ship. It is in reality the "family tree" of the particular machine tool to be built and when used to lay out or plan for running a quantity of machine tools through the shop, it automatically refers you to all perpetual inventory cards of raw, finished or purchased parts that go to make up the particular machine you anticipate manufacturing. You requisition raw and finished material and make the shop orders for the finished parts to be manufactured in your plant, in accordance with the instructions on each perpetual inventory card.

The second item of importance for a cost system is a system that will insure checking your employees' time against time clock cards or records of attendance. This, of course, must also give the proportion of time spent on direct labor and on indirect labor, or productive and non-productive labor, and you must remember that non-productive labor is a very important point when it comes to figuring your annual budget, a matter which I will speak of later.

The third item is that a cost system should provide for a carefully laid out budget and simple records to show that each department is operating within the limits set by this budget, and which will establish separate departmental overheads. You are not getting accurate costs, nor are you approaching accurate costs, when you figure burden or overhead as a percentage of labor. Work done in your plant on a $30,000 planer certainly deserves a greater burden than work done on a $25 bench.

The division of your factory burden or overhead into your respective departments is not a difficult task, and furthermore will not add materially to your clerical labor. We actually experienced a simplification of the duty in our bookkeeping department after adopting the department overhead system. In establishing a department overhead, you must make up your burden for:

1. Direct accounts controllable by the Department foreman or management, i.e.
   - (a) Salaries and wages.
   - (b) Miscellaneous supplies.
   - (c) Light.
   - (d) Fuel.
   - (e) Power.
   - (f) Water.
   - (g) Maintenance.
   - (h) Reclamation.

2. Direct accounts not controllable by Foremen or Management, as
   - (a) Insurance.
   - (b) Taxes.
   - (c) Depreciation.

And then each department must show its burden of the Indirect Accounts, as

- (a) Tool Room.
- (b) Tool Crib.
- (c) Pattern Shop.
- (d) Stores.
- (e) Heating Plant.
- (f) Maintenance.

And further, each department must bear its share of the general administrative burden.

To arrive at your department overhead on an hourly-burden basis, you divide the total department overhead, as indicated above, by the total production hours in the respective departments. For example, one man working 50 hours per week would work 2,600 hours per year, and if you employed ten productive men in a given department, you would have 26,000 productive hours. If further, the total department overhead came to $10,000, then your department overhead rate per hour would be $10,000 divided by 26,000 hours, or 38½c. per hour. It will, of course, be apparent that your overhead rate in your assembly department will be much lower than the overhead rate in your planer department, as your investment in the assembly department is very much lower than your investment in the planer department.

Finally, the fourth item, records that will give you a true factory cost of your product and route the work through your shop. The general method of figuring the cost of a machine tool is to have your cost department add up the factory cost of all the parts that go to make up the machine tool. This procedure invites a very large percentage of error. First, the costs are not your present-day costs, as some of the parts were made in large quantities months ago under varying

labor conditions and corresponding differences in labor rates. Second, a machine tool is made up of a very large number of manufactured parts and to accumulate and record the factory cost of all of these parts necessitates clerical work with a correspondingly large percentage of error. In our plant we maintain the factory cost of the individual parts of our machine tools for repair part service only.

During one of our periodic cost department surveys, we figure the *total number of hours* that it takes to produce each one of our machines in the *different departments*. In other words, except for repair part orders, we maintain in our cost department only the *time element*. We record and maintain a record of the time necessary to complete the different parts in the different departments, but we do not carry out continuously the cost involved in manufacturing these different parts. This is because there is too great a variation in the dollar and cents element. There is, for example, a big variation in wages and of course there is a big variation caused by the different hour rates of the men actually doing the work. Now, the total number of hours in a department, say the total number of hours of lathe work necessary to complete a finished machine tool, or the total number of hours of milling machine work to complete the same machine tool, is not going to vary materially unless some change is made in the design of the machine tool itself, or changes are made in the method of machining the parts, or unless some big labor-saving machine is placed in those departments, which will materially affect the hours spent in those respective departments in making the finished machine.

Finally, please refer to the accompanying illustration, which indicates the method of computing the list price of an imaginary machine tool in an imaginary plant. Work must be performed upon this particular machine tool in the cleaning, planing, drilling, milling and assembly departments of this plant. The second column represents the total hours of productive labor in the respective departments. The third column, the average rate paid to the direct-labor the day you desire to arrive at this cost, and this average rate can easily be secured from your factory departmental payroll book. The fourth column gives the total direct-labor spent in the different departments. The fifth column represents the departmental overhead rate as previously referred to, and each of the rates, multiplied by the hours of work in the respective departments, will give you a total overhead or burden in these departments.

We find a total of $123 of productive labor and a total of $82.80 overhead, or a factory cost (less materials) of $123 plus $82.80 or $205.80.

The weight of the raw materials going to make up a finished machine tool will vary but slightly from year to year unless, of course, changes are made in the design, and so with the day's market prices before you, costs of the raw materials going in to make up this machine are easily computed. In this case we find 1,000 lb. of gray iron, 100 lb. of cold rolled steel, 20 lb. of bronze, which at indicated prices make a cost of raw materials of $70. Finished materials purchased, such as oil caps, bronze or ball bearings, belts, pulleys, etc., come to $30, giving us a total factory cost of $205.80 plus $70 plus $30, or $305.80. To arrive at the list price of this imaginary machine tool, you must add the percentage of selling expense, the percentage of profit and safety, and the allowance for the dealer's commission. The result is your list price.

Locomotive Main Rods with Solid Ends

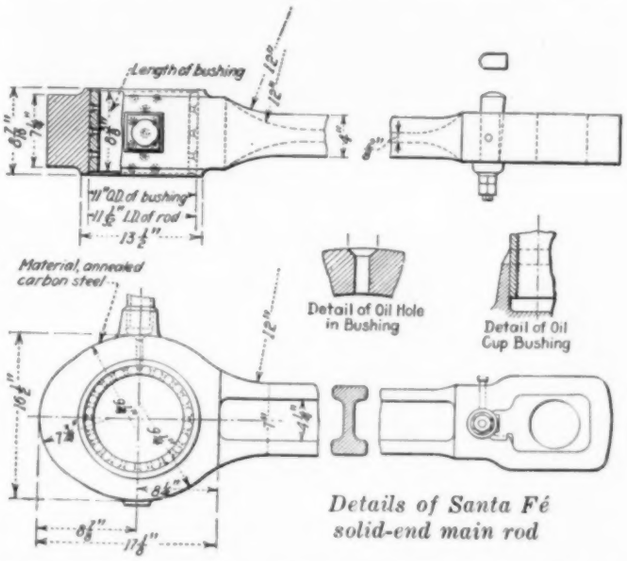
The introduction of solid-end locomotive side rods, approximately 40 years ago, eliminated a lot of trouble in the shape of broken rods, frequently due to improper adjustment of the straps and wedges at each end. Those who remember this change will also recall the opposition from the engineers and the kicks at the noise the solid-end rods make at times. The old time engineer got as much fun out of tinkering with the side rods of the locomotive as the modern engineer does in exploring the mysteries of his automobile.

The solid-end main rod is now being tried out on a few roads, the Santa Fé being one of the pioneers in this innovation. Details of the back end of this type of rod used by it are shown herewith. A carbon-steel rod is used for locomotives with crankpins varying from 8½ to 9 in., the dimensions shown being for rods for pins within this range.

A floating bronze bushing is used, the thickness depending on the pin diameter, and varying from approximately 1 to 1⅝ in. The length is 8⅜ in. in all cases.

There are seven circular rows of ¼-in. grease holes, staggered as indicated by the upper view, each row containing twelve holes. The outer end of each hole is countersunk to ½ in. diameter, as shown in the detail. As will be seen by the dimensions, there is 1/32 in. clearance between the bushing and the hole in the rod end. The clearance between the bushing and the crankpin is about 1/64 in., giving a total of 1/32 in. when new. Ample space is provided by the clearance for a film of lubricant, grease in this case, between the bearing surfaces.

The oil cup detail is also shown. While the body of the cup is formed in the rod itself, there is a threaded extension welded in as shown. Trouble from stripping a thread in the rod is thereby prevented.



Details of Santa Fé solid-end main rod

Ideas from Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

Spare Motor and Motor Repair Platform

BY JACK WILLIAMS

The modern induction motor is a pretty dependable piece of machinery and ordinarily requires very little in the way of attention or repairs, but it cannot be expected to run forever and when it *does* go to the bad it usually involves shutting down the shop—or at least that portion of it depending upon the particular motor—until repairs or substitution can be made. Also,

Spare motor and motor repair platform

a motor suspended from the ceiling is in an excellent place to be out of the way of everybody while it is doing its work, but a very inconvenient place in which to make repairs.

In the shop where the Gridley Automatics are made, at Windsor, Vt., the group drive plan is followed, and there are fifty or more overhead motors, each driving one bay of the shop and each suspended over the long open passage-way that extends down through the middle of every building. The photograph shows the arrangement

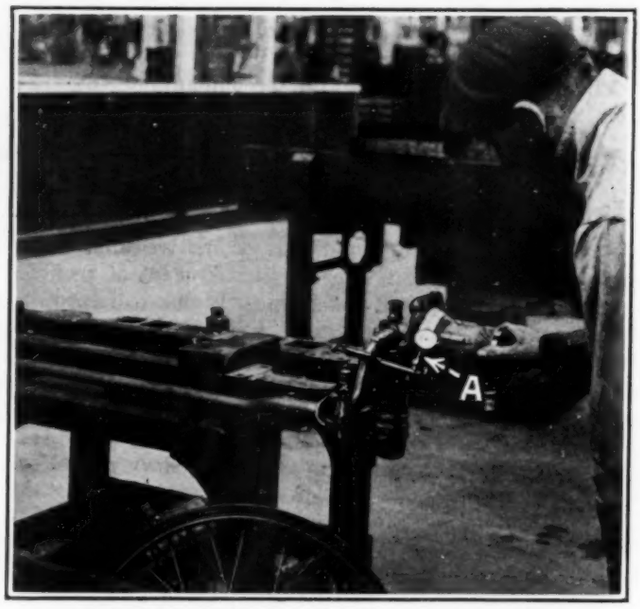
A spare motor with its starting transformer is permanently mounted on a heavy metal-framed truck that is provided with means of braking its wheels so that it may not readily be moved out of its position, and when a repair or adjustment of a regular motor is necessary the "democrat"—as it is called by the shop men—is wheeled under the line shaft, the endless belt run off the pulley of the overhead motor and onto the pulley of the spare, the three wires plugged into the nearest junction box, and in five minutes the machinery of that part of the shop is again in operation.

To make the repair on the idle motor a substantially braced and comfortable sized platform on casters is rolled under it, and upon this platform the millwrights and electricians can work as easily and safely as if they were on the floor of the shop.

Testing a Front-Wheel Spider

BY CLIFFORD H. FRENCH

The illustration shows the method used in the Marmon factory for testing the truth or concentricity of the spiders or sleeves that fit inside the hubs of the



Inspecting wheel spider for concentricity

wire wheels on the front axle. The front axle assembly is clamped in position on a bench of convenient height for the inspector, and a specially mounted dial indicator is fastened to the steering arm as shown at *A*.

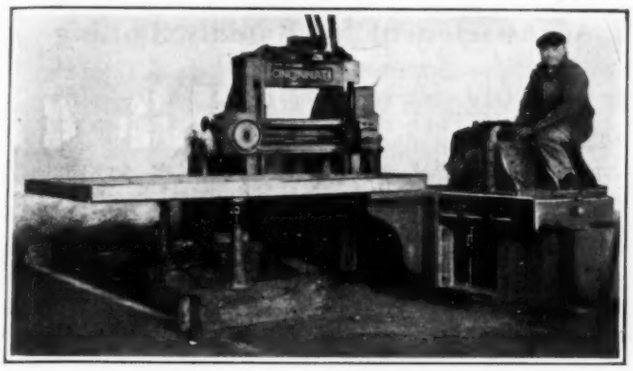
The indicator is readily attached by means of a knurled screw, and the holder is so positioned as to bring the contact point of the indicator in its proper position on the taper seat on which the wheel hub fits. It is then only necessary to revolve the spider on the stub axle, to have the needle of the indicator show at once the amount of eccentricity which exists between the inner and outer surfaces of the spider.

Unusual Jobs in the Repair Shop

By Edgar H. Trick

Recently our firm undertook to supply a casting of unusual size and shape to be used in building construction. Its section was a sort of skewed "rectangle" in shape, with its major dimension something in excess of 17 ft. and weighing over 2,500 pounds. Since it had to fit exactly between a planed baseplate set in concrete and a heavy steel beam overhead, both of the oddly shaped end pads had to be faced.

We had no equipment to handle the piece. The lathe that would swing it was not long enough between centers and the lathe that was long enough would not



A big job on a small planer

swing it; nor was there a shaper or slotter in the shop of sufficient capacity. After considerable figuring as to the most economical method to employ, we determined to do the job on an ordinary planer of medium size and in the manner here described.

We first cast a heavy angle-plate and faced one of the surfaces only. This plate we attached to the bed of the planer with suitable stud-bolts, carefully levelling and aligning the planed surface of the plate with the table of the planer by means of adjusting screws through the rough side of the plate. After securing it firmly we dammed the opening around the edges of the plate and poured the space between plate and planer bed full of hard babbitt.

We then secured another and somewhat smaller angle-plate to the planer table and to it we bolted one of the regular tool heads, removed from the cross-rail. The casting was mounted with the end to be planed resting upon the stationary angle-plate, and the outer end supported by a screw-jack. The jack enabled us to square up the work vertically with the minimum of effort.

When all was ready the planer was started and the operator, climbing upon the moving table, manipulated the tool by hand as he rode back and forth with it. The work was completed in a very satisfactory manner and at a cost but slightly in excess of what it would have been had we been able to do the work in a lathe.

A few months later a similar problem was presented in the shape of some large cast-iron doors measuring 5x7½ ft., the sides and ends of which were to be machined, as well as two transverse bearing pads about 2 in. wide and located about 1 ft. from the top and bottom of each door respectively. To do the work we proceeded in the same manner, using two angle-plates in this case and bolting them to the bed of a 36-in. Cincinnati planer, as shown in the accompanying illustration.

Great care had to be exercised in aligning the planed faces of the angle-plates with the surface of the planer table, but once adjusted and the joint between plates and planer bed filled with babbitt, the actual work of planing was accomplished without difficulty or undue expense. The overhanging weight of the castings was supported upon two screw-jacks, which lent themselves readily to the process of lining up, and the saddle of the planer was removed from the cross-rail and mounted upon an angle-plate on the table as before.

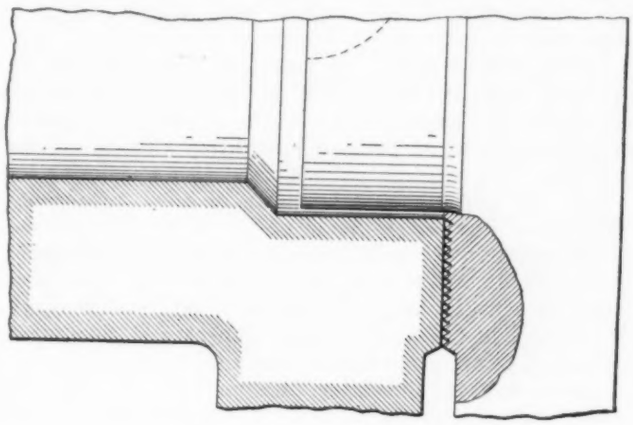
Steam-Tight Joints on Locomotive Cylinder Heads

By F. M. A'Hearn

That the time-honored practice of grinding the joints of locomotive cylinder-heads is still followed, is evidenced by the labor-saving devices described from time to time in mechanical publications, which show how to utilize air or electric motors in grinding the joints. At a convention of railway mechanical men held recently, a device of this kind was described by a committee reporting on labor-saving tools for shops and roundhouses.

A method of saving all the labor required in grinding cylinder heads is probably of more interest to those engaged in locomotive maintenance than would be an easy way of grinding the joints. It is shown in the illustration herewith.

After facing the joint in the lathe or boring mill, in the same manner as would be done preparatory for grinding, the surface is serrated or grooved so as to resemble a partially finished thread, the grooves being



A grooved steam-tight joint

approximately twice as wide as the flat surfaces remaining between them. The grooves are cut by using an eight- or ten-thread discarded bolt cutter chaser, secured in a suitable holder. A few revolutions of the work will finish the joint. As the joint then consists of six or eight concentric rings, each from 3½ to ¾ in. in width, it will be seen that the narrow faces can be drawn to a bearing much easier than can a surface of from ¾ to 1 in. in width. Some shops paint the joints with white lead or varnish before applying the heads, others claim equally good results without coating the surfaces.

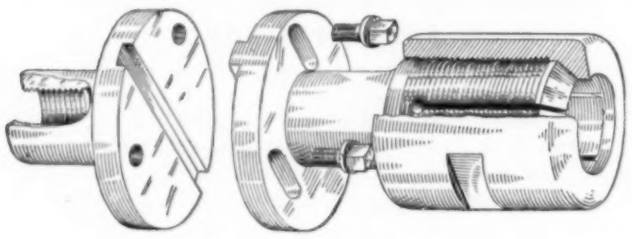
The method is entirely successful, having passed the experimental stage several years ago.

Chuck for Making Eccentric Bushings

By Arthur Silvester

My way of making eccentric bushings, is to turn and finish the outside diameter of the stock first, then put it in the special chuck shown in the illustration, and with the chuck offset to the required degree of eccentricity bore and finish the hole. Because of the large gripping surface available on the outside of the bushing, there is little liability for the partially finished work to slip.

If the bushings were first bored and then turned on an eccentric arbor, a special arbor would be necessary



Chuck for eccentric bushings

for each separate degree of eccentricity and an expansion bushing (or another arbor) for every diameter of hole but one. By my method the expansion bushings are necessary for every outside diameter but one, but only one chuck is required for all degrees of eccentricity, and the diameter of the hole may be anything within the limits of the bushing.

To make the chuck, a special faceplate for the lathe is required. This may be of cast iron, and of any size, depending upon the probable requirements of the shop in the way of eccentric bushings. It is fitted to the spindle nose in the regular way and is, in fact, very much like the usual driveplate except that it has a square groove across its face. The groove may be undercut and the corresponding tenon dovetailed to match, if the maker is at all fussy, but the square groove serves every purpose. In either case the tenon must be fitted nicely to slide freely without shake.

The next piece should be made of steel, preferably tool steel. One end is made of the same diameter as the faceplate, and provided with a tongue, or tenon, across its diameter to match the groove in the faceplate, as above noted. The piece is then necked down for a short distance, the length of neck and amount of reduction in diameter being just sufficient to allow for the introduction and later manipulation of the two collar-head screws by which it is attached to the faceplate.

As will be seen in the sketch, slotted holes in this piece extend parallel to the tenon for a distance sufficient to provide the extreme amount of offset required, but need allow for adjustment in one direction only from the center. By taking this feature into consideration, the tapped holes in the faceplate may be located considerably to one side of the diameter and thus render available a much greater range of offset than would be the case if the holes were symmetrically located. The larger the diameter of the neck, and the shorter its length, the stiffer will be the chuck. These dimensions are a matter of individual design, depending upon the desired size of work and the range of offset.

The business end of the chuck is made like a spring collet, and has a knurled sleeve threaded upon it to close it upon the work. The outer end is beveled to about a 45-deg. angle and a corresponding bevel made in the bore of the sleeve. The body of the chuck should be slotted in three places, 120 deg. apart, the slots running nearly to the depth of the bore. If a toolpost grinder is available a much better job may be done if the gripping portion of the chuck is toughened in oil and the bore ground in place upon the lathe in which it is to be used.

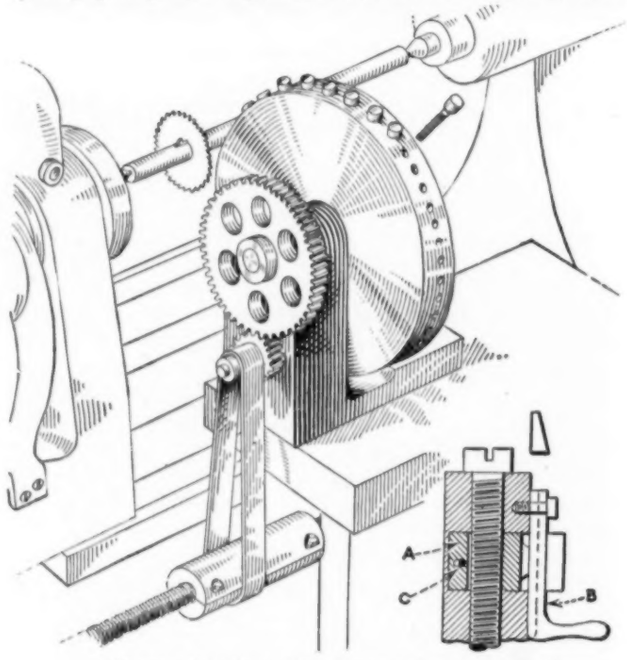
Like the eccentric arbor, the chuck is limited to one outside diameter as the arbor is limited to one inside diameter, but by making a set of flexible bushings, any desired smaller size may be held.

An Attachment for Rapidly Slotting Screws on a Lathe

By John Stewart

The attachment illustrated was used to slot a large number of special screws, standard as to thread, but extremely long, and having cylindrical heads.

The cutter arbor, held between the centers of the lathe, was driven by a dog. Power to revolve the drum, or rotating part of the fixture, was obtained by means of two spur gears, two pulleys and a belt. The split driving pulley was tightened around the lead screw of



Screw-slotting attachment for lathe

the lathe. The bracket which supported the fixture was attached to the carriage.

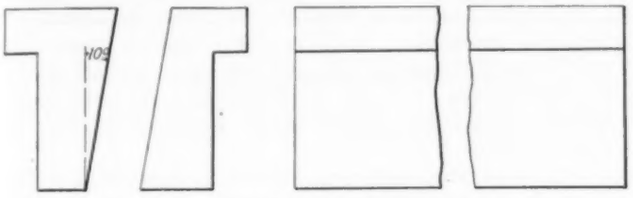
The sectional drawing shows the method of holding the screw in the drum. The pin *A* was drilled with a clearance hole to receive the screw and was clamped against it by the knife edge clamp *B* acting against the underside of the head of the pin. When the clamp was forced against the pin, the pin itself was forced out until it had reached the limit of its travel, controlled by the stop pin *C*.

The capacity of the fixture was 60 holes, and it was possible to slot 60 screws per minute, which was the time for one revolution of the drum.

Vise Jaws to Hold Form Tools

By Alfred T. Gregory

The sketch shows a pair of false jaws, or angular parallels, for use in the shaper vise. They are very handy when one has a good deal of form tool work to do, as their shape eliminates the necessity for using a pro-



Angular parallels for shaper work

tractor when setting up the job. They may be made of any desired face angle up to 15 deg., but beyond this angle one of them will exhibit an annoying tendency to rise in the vise when the clamping pressure is applied. This tendency can be counteracted by making the top flange wider and fastening the parallels to the vise jaws by means of countersunk head screws, or by drilling holes transversely through them to correspond with the bolt holes in the regular jaw faces, and substituting them for the latter.

Keeping Cold-Rolled Bars Straight

By Francis C. Henry

Those who have had experience with cold-rolled steel know its tendency to curl up and look at you when you remove the surface from one side. Cutting away the surface which has been given a hardness or tension by

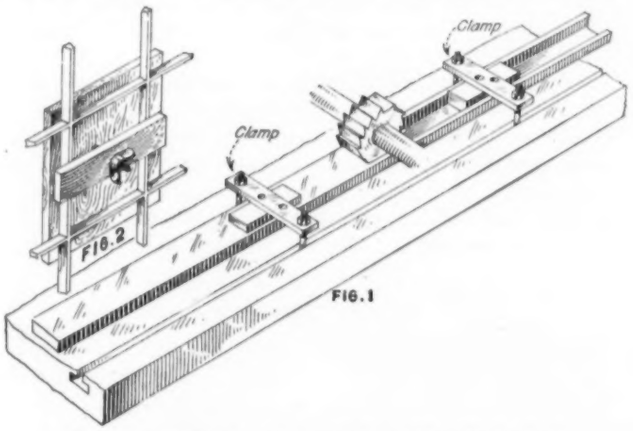


Fig. 1—Milling a channel in cold-rolled steel
Fig. 2—A temporary window board

rolling, seems to make it forget all about following the straight and narrow path and it immediately begins to wander all over the lot.

I saw a job the other day, however, where some cold-rolled bars, about ¾x2 in. and approximately 12 ft. long, had been persuaded to stay remarkably straight under such circumstances. At least half of the metal was milled away as can be seen by the sketch, Fig. 1, leaving one side the full thickness of the bar but cutting the center down into a channel and the other edge only ½ in. thick. The machinist, however, seemed to know cold-rolled by its first name and proceeded to keep it from springing by clamping the bar very close to the milling cutter all the time. He did not leave over 6 in. unclamped where the cutter was at work.

It was necessary to shift the clamps frequently but the bars remained very straight, and it was cheaper and better to do this than to try and coax them straight afterward.

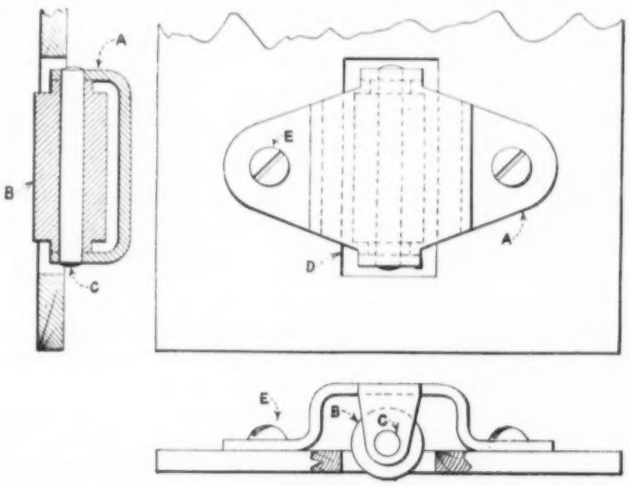
The milling machine was very near a window and the bar had to be fed through the window for four or five feet. So the machinist simply removed a pane of glass, fitted a board on the outside and held it by a cross piece in the inside, a bolt and wing nut holding the board in place, as shown in Fig. 2. Then when the bar being milled reached the window, he loosened the wing nut, raised the board enough to let the bar feed through and closed it again as soon as the bar was completed. This saved the window pane and reduced the annoyance of having the window open in cold weather.

Helping the T-Square to Slide

By Edward Heller

When using a very long T-square, the right-hand end always tends to lag behind when the other end is moved. Unless the draftsman is on his guard at all times, he may be drawing lines while the T-square is off. The device shown in the accompanying sketch has been put on a number of long T-squares and helps very much to make them slide more easily.

The attachment consists of a bracket *A*, a roller *B* and a pin *C*. The bracket is made of brass, $\frac{1}{16}$ in. or



Roller for the T-square

heavier, cut to the required shape and bent as shown. The holes for the pin *C* are drilled and line reamed after the piece is bent to shape. The roller *B* is about 1-in. long overall and $\frac{3}{8}$ in. in diameter. It is turned slightly barrel-shaped and the ends are turned down to form the small hubs shown. It can be made of brass or steel. The pin *C* is a piece of drill rod about $\frac{1}{4}$-in. diameter and is a light press fit in the roller *B*, and a running fit in the reamed holes in the bracket *A*.

A rectangular hole *D*, is cut in the end of the T-square, and the whole thing fastened to the blade by means of wood screws as at *E*. The shape of the bracket will to some extent depend on the thickness of the T-square blade. It is well to shape the bracket so the roller *B* will project about $\frac{1}{32}$ in. below the blade.

American Machinist
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KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

The Repair Shop Is an Important Link in the Railroad Chain

THE question as to which department of a manufacturing establishment should be credited with the success of the concern comes up every now and then. The shop claims that it is making the money and the designer is an incubus. The sales department claims that it is entitled to all of the credit and a large portion of the cash while the shop is merely responsible for delays and disappointments in delivery and the designer for the less desirable features of the machine. On the other hand, the designer claims that neither the shop nor the sales department would have had much of a show without him and his work.

Meanwhile the wise president of the concern sits in his office and smiles, knowing very well that all three are necessary to him and to each other.

The same question as to which department is responsible for the profitable operation of a railroad might be asked and should be answered in the same way. Unfortunately there is one department of the railroad that is so far removed from the point where the profits are counted that even the president may be half-way excused for thinking that it is merely an expense, a necessary evil to be held down to its smallest possible dimensions. That department is the repair shop.

It is undoubtedly due to the great distance between the railroad shop and the accounting department that railroad repair shops are generally treated in a stepmotherly way, that very seldom a sufficient amount of money is spent on them and that it is but rarely that a really high-class executive is deliberately placed in charge of them. Where there is such an executive it is because he happens to be an unusual man, not because sufficient inducements are held out to attract one from the outside. And furthermore, where such a man grows up in the railroad shop and becomes a high grade executive it is but rarely that he is given the power and the encouragement to carry his ideas into execution. All this is because the head of the railroad does not realize that the railroad shop is as much a part of the organization and the equipment of the road as are the locomotive, the freight car, the passenger car, the terminal, the track and the personnel.

The Psychology of the Scrap Pile

A MAN feels better in the spring when clean-up week has passed and he is rid of the junk pile that had accumulated in his back yard during summer, fall and winter. The members of his family feel better, too.

Analogous to the backyard junk heap is the scrap pile in the factory yard. The relative size of the scrap heap and the amount of orderly arrangement and sorting of the scrap are a fair measure of the efficiency of the plant. Steel, iron and brass should be kept in separate piles or bins and the amount should be kept low. If a man sees a great heap of rejected parts in the yard, he feels that if he spoils some more, they will make little difference when added to that big pile. If he sees a big bunch of castings that his neighbor spoiled lying in the old pile for months, he is going to get the impression that they were not a very big loss.

It might not be a bad plan to have the scrap pile in some prominent location where almost every employee would have to pass it each day. Then make it a point to keep that pile so small that any individual's spoiled work, when added to it, would stand out like a wart on a nose.

The average worker is conscientious if his conscience is stimulated once in a while. If he made scrap that was added to that pile, he would be right glad when clean-up day was over.

Saving Where It Will Do the Most Good

FOR years the machine building industries have been working to reduce manufacturing costs and the results obtained have really been remarkable. In many shops manufacturing methods have been so highly developed that it is something of an achievement to save a fraction of a cent in the cost of an operation.

A serious question facing many a shop executive is whether the small savings now possible will be sufficient to repay the company for the effort expended in securing them. From the point of view of the general manager it may be worth while to look around for some other cost factor to reduce. Even a cursory investigation will probably show that the overhead item is disproportionately high as compared to direct labor. If this condition exists, and we venture to say that it exists in ninety-nine shops out of a hundred, isn't it reasonable to suggest that more attention be paid to overhead?

Of course the revision of the work of departments and individuals the efforts of which are generally included in overhead, may result in the elimination of certain high-salaried officials. But even so the company will benefit and if the officials in question are unable to find good jobs elsewhere in the company, or outside of it, the chances are that they were overpaid anyway.

Just Suppose

JUST suppose that in any and every shop there were standard data sheets for all the machine tools in the shop. Just suppose that those sheets gave all the information needed by the tool designer, the purchasing agent, the estimator, the time study man, the maintenance boss and the plant engineer.

Then just suppose that they were of a standard size and of a standard layout, and the data for each machine tied up with the builder's serial number. Wouldn't there be some saving in time and money? And wouldn't many costly mistakes be prevented?

You say you know there are such sheets? And that the only trouble is the machine tool builders are too individualistic to adopt them?

Well, maybe so, but quite a few have adopted them and others are about to do so. Suppose they all did—

Just suppose.

Shop Equipment News

New Britain "New-Matic" Chucking Machine

A horizontal chucking machine with rotating work spindles, and adapted for facing, forming, drilling and reaming operations on forgings and castings, has recently been placed on the market by the New Britain Machine Co., New Britain, Conn. This machine is designated the "New-Matic" on account of its recent development and the incorporation of an air-operated control system. The range of work for which it is particularly adapted consists of pieces that can be conveniently chucked in the horizontal position and handled with one hand.

The multiple spindle arrangement of the machine shortens the machining time on this work to such an extent that the limit of production is usually set by the ability of the operator to handle the work into and out of the machine quickly. For this reason the stopping and starting of the spindle and the opening and closing of the chuck are controlled by a pneumatic arrangement in order to decrease the loading time.

A general view of the machine is shown in Fig. 1. The turret in which the work spindles are mounted is located just to the left of the center of the machine with the indexing mechanism below and the chucking and spindle clutch mechanism at the left. The air valve by which the pneumatic control is operated is mounted on the front of the turret housing. The longitudinal tool slide is located directly in front of the chucks and is driven by the large drum cam below and to the right. The cross slides are actuated by cams on the same shaft as the large drum, the motion being transmitted through heavy bell cranks. The box at the extreme right-hand end of the machine contains the change gears by which the required changes of speed and feed are obtained.

The machine is driven through a friction clutch from the single driving pulley. For driving the work spindles the power is transmitted through change gears to a longitudinal shaft that passes through the center of the work spindle turret to the other end of the machine. At this end of the longitudinal shaft is mounted a spur gear that engages with the various clutch gears on the work-holding spindles, these clutches controlling the rotation of the spindles.

The apparatus for controlling the functions of the spindles and chucks consists of an air cylinder located at the left-hand end of the machine, the piston of the cylinder being attached to a cam slide located immediately above. The position of these parts is clearly shown in Fig. 1, the cams being attached to the back of the slide. When the turret indexes and brings one of the work spindles into the loading position, the air valve is operated in the proper direction, the resultant movement of the cam slide causing the spindle clutch to be released on that particular spindle. A brake is then automatically applied to stop the spindle and the mechanism that releases the chuck is actuated. These functions are performed in sequence and during a single stroke of the air cylinder piston and cam slide.

The finished part is then removed and a blank is placed in the chuck, after which the air valve is moved in the reverse direction and, as the cam

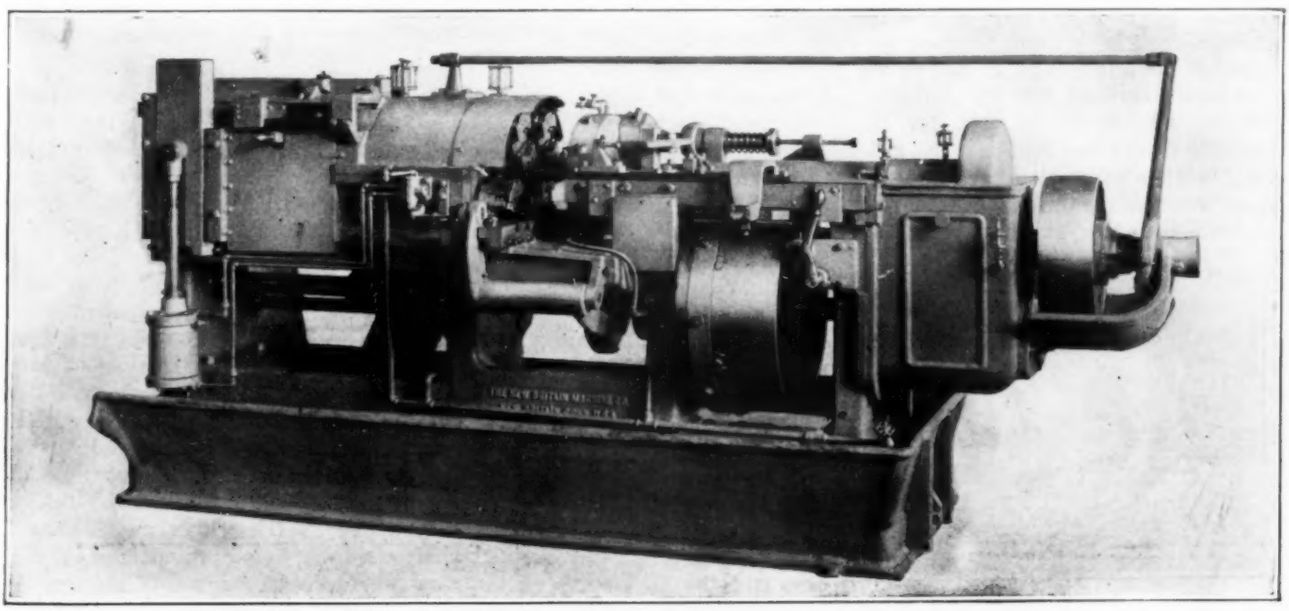


Fig. 1—New Britain "New-Matic" Chucking Machine

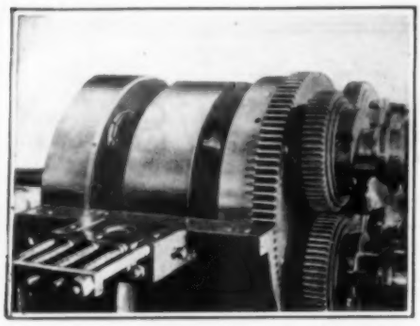


Fig. 2—Work spindle cylinder of the "New-Matic"

slide moves to its original position, the above-mentioned functions are performed in reverse order. First, the chuck closes; then the brake is released; and finally the clutch is engaged, starting the rotation again. If the operator should find that the piece is not properly chucked and out of center after the rotation is started, the spindle can be again stopped, the piece properly placed and the spindle started. If the chucking operation requires more time than the cycle allows, the machine is started by manipulating the clutch handle located at the right of the main cam drum in Fig. 1. This handle is interlocked with the air-operated cam slide so that the cycle cannot be started until the slide has reached its original position, causing the chuck to be closed and the spindle to rotate.

The spindle turret is shown with its cover removed in Fig. 2 and its remarkably heavy construction and rigid mounting can be noted. In effect, there are three drums connected by two sections of smaller diameter. The outside forward section, at the left in Fig. 2, carries the forward bearings for the spindles; the middle section is used for the spindle thrust bearings and the locking bolt slots; and the rear section provides the mounting for the rear spindle bearings and the ring gear by which the turret is rotated. This turret or cylinder is cast in one piece and finished all over, there being no cored opening at the center.

The spindle clutch gears, cones and operating fingers are shown at the right in Fig. 2, the mechanism for actuating the chucks being located at the extreme outer ends of the spindles. The machine ilustrated is equipped with two-jaw external gripping chucks, mounted on the ends of the spindle noses and operated by draw rods extending through the spindles to the chucking blocks at the ends. The chucking blocks are operated by the air-controlled cam slide when in the loading position, and are equipped with compression springs so that the mechanism will compensate for slight variations in the size of the work.

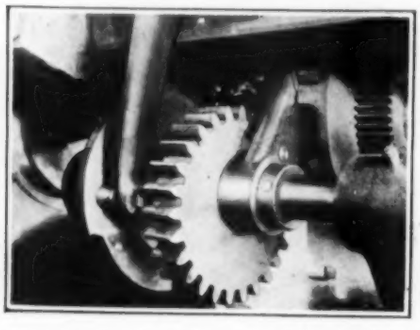


Fig. 3—Locking bolt cam and elliptic gear for Geneva motion

The spindles are made from heat-treated chorme-vanadium steel forgings and are mounted in plain cylindrical bronze bearings that are tapered on the outside for adjustment. When setting up the machine the clutches and chucks may be operated by hand, using a chucking fork between the clutch or chuck wedges and the brake spool.

The locking bolt, as shown in Fig. 2, is wide and heavy and is forced into the index notch by three compression springs. It is withdrawn before indexing by a reversing cam lever actuated by a cam below. This cam and the lower end of the cam lever are shown in Fig. 3, together with the indexing mechanism for the work spindle cylinder. The indexing mechanism consists of a form of the well-known Geneva-stop motion, in which the crank is driven through a pair of elliptical gears. This method of driving provides a rapid movement of the crank during indexing so that the operation requires a relatively small portion of the cycle time. The gear on the back of the Geneva plate at the extreme right in Fig. 3 meshes with the ring gear on the cylinder, previously mentioned.

The feed mechanism for the tool slides is driven from the longitudinal shaft that also drives the work spindles, the power being transmitted through change gears to a driving pinion shaft. A clutch in this drive is controlled by the clutch handle previously mentioned, the pinion meshing with a large internal gear mounted on the inside of the main cam drum. This method of driving the camshaft reduces the torque in the shaft and provides a drive that is sufficiently rigid to produce smooth action for the cutting tools.

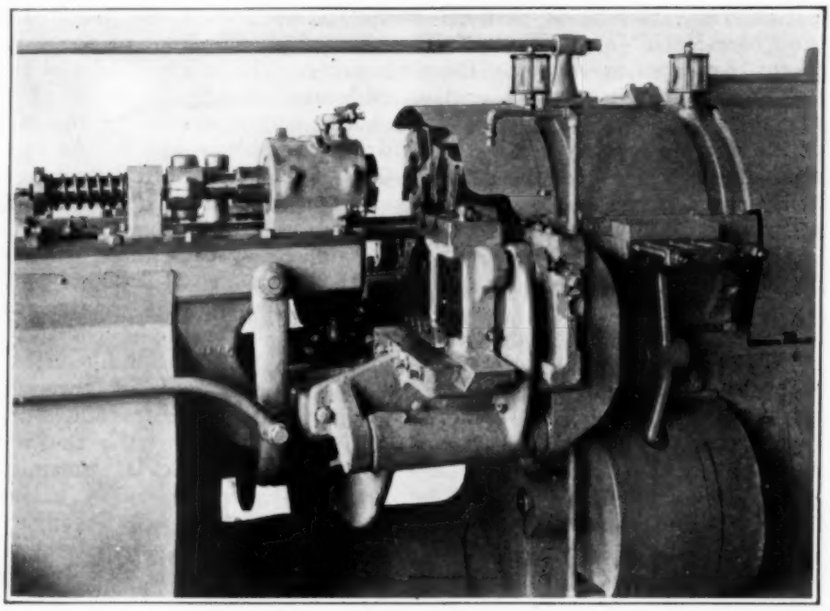


Fig. 4—Rear view of "New-Matic" showing tool slides and chucks

The cam for moving the longitudinal tool slide is attached to the outer surface of the cam drum and is universal, in that it does not have to be changed for different strokes. The cam is set in the proper position on the drum to suit the stroke required, setting lines and T-slots for clamping being provided on the drum surface. The thrust of the tool slide against the cam is taken by a hardened steel thrust block fastened to

the frame and in contact with the edge of the drum as it rotates.

The cross slides are operated by cams mounted on the same shaft as the large drum. The way in which these slides are mounted in the frame of the machine and driven by a bell crank is shown in the view of the rear slide in Fig. 4. These cams are so located on the camshaft that they are not in line with the falling chips from the cutting position. The camshaft passes through the frame to the space under the spindle cylinder where it carries the cam for the locking bolt and the elliptical gear for driving the Geneva index mechanism.

If the nature of the work on which the machine is to be used makes it a disadvantage to use the air-operated chucks, the machine may be equipped with hand-operated chucks, collets or fixtures; but the pneumatic control is retained for starting and stopping the spindles and actuating the interlock. The machine is built in two sizes and each size is made with either four or six work spindles. On the four-spindle machines there are four tool stations on the longitudinal slide, one station on the front cross slide, and two stations on the rear slide. The tools on the cross slides may be used separately from those on the longitudinal slide or in conjunction with them.

For the purpose of observing the relative movements of the various parts while setting up the machine, the movement of the tool slides and the indexing of the spindles may be accomplished by hand. This is done by means of a hand crank attached to the camshaft mechanism after the power drive has been disconnected. It is impossible to leave this handle on and engage the power feed at the same time.

The longitudinal tool slide is equipped with an accelerating device, located to the left of the tool holder in Fig. 4. This device multiplies the movement of the tool carried in this position and a hole, for instance, which has been bored in two steps at preceding stations can be reamed for its full length by a tool carried in the accelerating device. A similar device is used to decelerate the tool for such an operation as taper reaming.

"Tero" Hand-Operated Internal Grinding Machine

The Giddings & Lewis Machine Co., Fond du Lac, Wis., has recently placed on the market a hand-operated internal grinding machine, which is designated "Tero" by the manufacturer. The machine is wholly self-contained and is motor-driven, three independent motors being provided to drive the work head, the grinding spindle head and the coolant pump, respectively.

The machine can be used for grinding holes from ½ in. in diameter up to the capacity of the machine, which is limited only by the 16-in. swing over the ways. Straight holes, blind and multiple diameter holes can be ground, as well as taper holes with an included angle not exceeding 30 deg. The grinder is carefully and accurately made throughout, all parts being made with suitable jigs to insure interchangeability and good operating qualities.

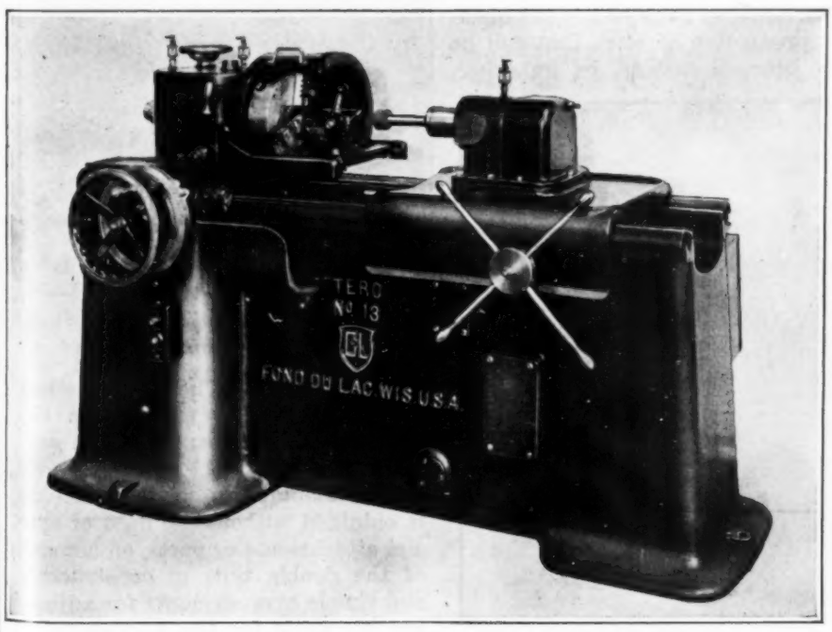


Fig. 1—"Tero" Hand-Operated Internal Grinding Machine

The base is a rigid box-section casting in which the water tank is cast integrally. One of the ways is V-shaped and the other is flat, both protected from water and abrasion by deep overhanging guards attached to the bed. The grinding carriage is arranged to slide upon the ways and is traversed by means of a pinion and rack operated by a large pilot wheel, the maximum travel being 21 in. The work head is moved across the machine by means of the hand-operated feed mechanism.

The work head carriage is a complete assembly as is shown at the left in Fig. 3, and includes the work head proper, the change gear box and the driving motor. The whole unit can be quickly removed from the machine and replaced. Six speeds for the work spindle are available through the change gear box, the changes being accomplished by setting the handwheel at the top of the head in the proper position. The driving motor has a capacity of 1 hp. and its shaft is mounted in ball bearings.

The change gears for the work head run in oil and the silent chain drive to the spindle is lubricated by the overflow from the spindle bearings. The spindle may be started and stopped at will without stopping the motor, a friction clutch being provided for this purpose. The head is swivelled for taper grinding by means of a micrometer screw. The spindle is made of high-carbon steel and is mounted in substantial bronze bearings. The hand feed wheel is equipped with a dial graduated to 0.0002 inch.

The grinding wheel unit is shown at the right in Fig. 3 with the belt guard removed. The wheel spindle is driven by an endless fabric belt from a 3-hp. ball-bearing motor suspended directly beneath the carriage and reciprocating with it. The wheel spindles are of the ball-bearing type arranged for quick mount-

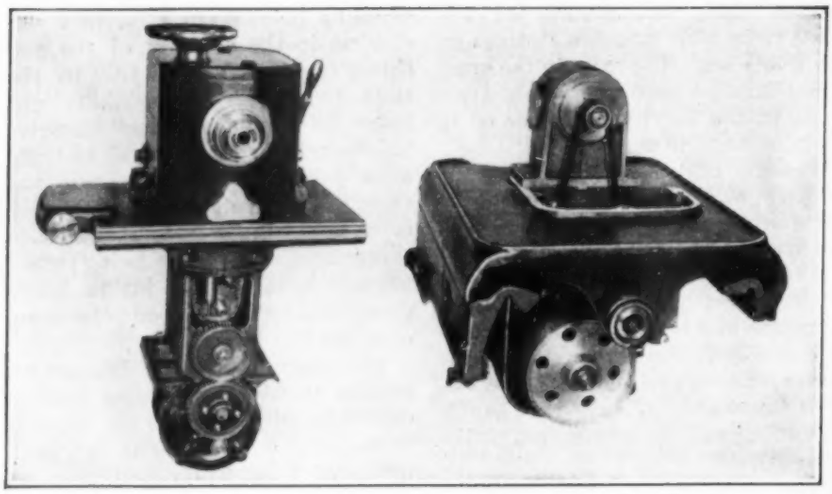


Fig. 2—Work spindle and grinding wheel heads

ing in the wheel head. It is recommended that several spindles, each with its proper pulley, be kept on hand to cover the full range of spindle speeds, since the changing of spindles is quickly and conveniently accomplished.

The wheel truing device is rigidly held when in its working position but is so mounted that it can easily be moved to facilitate gaging and replacing. For duplication of diameters to relatively close tolerances without gaging, the diamond can be set in correct relation to the circumference of the hole and the wheel dressed just before the finishing pass of the wheel.

The water pump is driven by a 1-hp. ball-bearing motor and is of the centrifugal type. The motor is connected to the pump by a flexible coupling and the whole unit is mounted on a bracket at the back of the machine. When the wheel is withdrawn from the work the water is automatically turned off, the valve being again opened when the wheel re-enters the work.

The floor space occupied by the machine is 4x7 ft. and its net weight is 3,700 pounds.

Lodge & Shipley "Duomatic" Lathe

A full automatic lathe, known as the "Duomatic" and designed for the advantageous use of multiple tooling arrangements in turning and facing operations, is now being marketed by the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. It is particularly adapted for the quantity production of work that can be held between centers, on an arbor, or in suitable work-holding fixtures.

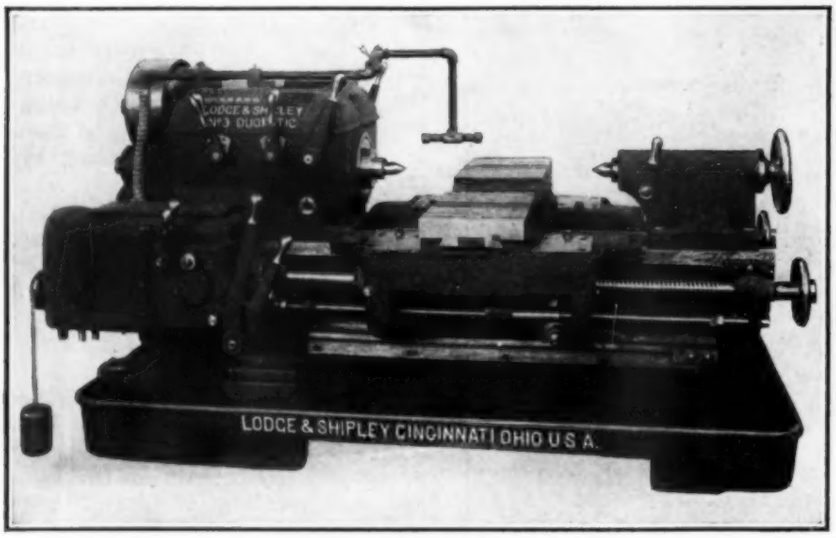


Fig. 1—Lodge & Shipley "Duomatic" Lathe

The cycle of operation of the machine is completely automatic, including the location of the lengths and diameters on the work piece, these dimensions being obtained through the use of positive metal-to-metal stops. The use of these stops is said to insure a high degree of accuracy.

As its name implies, the lathe is dual in character, since it has two

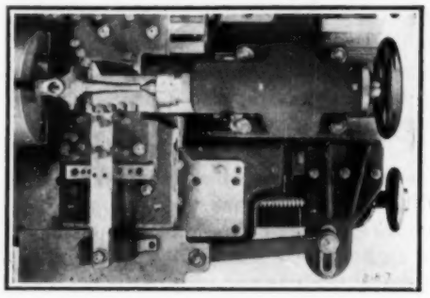


Fig. 2—Simultaneous straight and taper turning on a steering spindle

complete carriages with tool slides, each of which is provided with an independent quick forward and return traverse, as well as power feed to both tool carriages and tool slides. This arrangement adapts the machine for a wide variety of work, since both carriages can be used simultaneously in turning operations, or both tool slides can be used for facing, and, in addition, one carriage with its tool slide can be used in a turning operation while the other is performing a facing and fil-

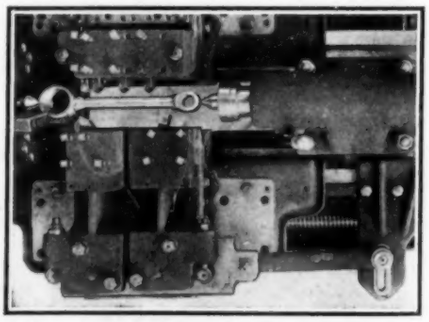


Fig. 3—Both carriages in use turning a tubular connecting rod

leting operation. The latter method of setting up the machine is the usual one and is adapted to the general run of work.

The adaptability of the machine is obtained without the need of special attachments or parts, on account of the double type of construction and simple arrangements for adjusting the units for the various functions. The cross-movement of the

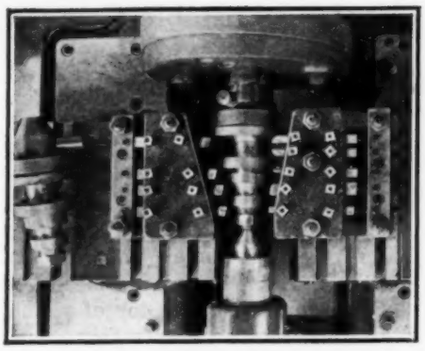


Fig. 4—Tool set-up for an automobile transmission cluster gear

tool slide and the longitudinal movement of the carriage are both obtained from the feed screw. An adjustable threaded micrometer sleeve is arranged to stop the movement of the cross-slide at the proper point and fix the diameter of the finished work. By the adjustment of a pair of nuts on a threaded stop bar it is also possible to limit the travel of the carriage in either direction.

Some of the ways in which the machine may be tooled for certain parts are shown in the accompanying illustrations. Fig. 2 illustrates the operation of turning a steering spindle for use with four wheel brakes, and it will be noted that both straight and taper turning are being accomplished at the same time. Both carriages are in use at the same time in Fig. 3, the operation being combined straight and form turning on a tubular connecting rod. Fig. 4 shows the tooling arrangements for machining an automobile transmission cluster gear.

The spindle of the machine is driven by a single pulley through a multiple plate clutch and alloy steel gearing. All shafts are mounted in ball bearings. All of the headstock and clutch mechanism is fully enclosed and provided with an automatic lubrication system.

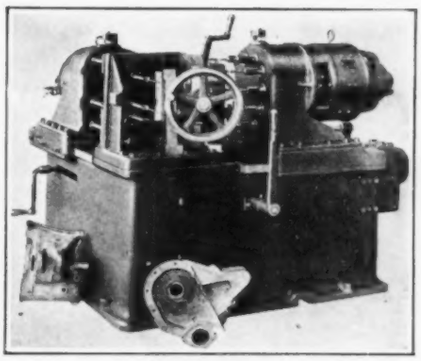


Fig. 2—Greenlee Right-Angle Horizontal Drilling Machine

gland is provided at each front spindle bearing to retain the oil in the head. A geared oil pump is mounted on each head and is driven from one of the intermediate gears. The oil is pumped from a settling tank at the bottom of the head to a small reservoir, from which it is piped to the various lubricating points.

The head slides are mounted on flat ways provided with gibs to adjust for wear, and are guided by one way only. The machines illustrated in Figs. 1 and 2 have screw-operated feeds for the heads. The feed box is built as a unit and mounted on the frame between the ways at one end of the machine, where it receives power from the head through gearing and a splined shaft. The feed nuts are carried on the bottom of the head slides, the feed gearing being engaged by means of a hand-operated jaw clutch.

When the drills have reached the desired depth a suitable mechanism disengages the forward feed clutch and engages the reverse, returning the head to its original position. The head returns at 100 in. per min., a

Greenlee Bros. Multiple-Spindle Drilling Machines

A series of single-purpose, high-production drilling and tapping machines has recently been added to the line of equipment manufactured by Greenlee Bros. & Co., 12th St. and Columbia Ave, Rockford, Ill. These machines are designed to suit the work on which they are to be used, but are made up from a series of

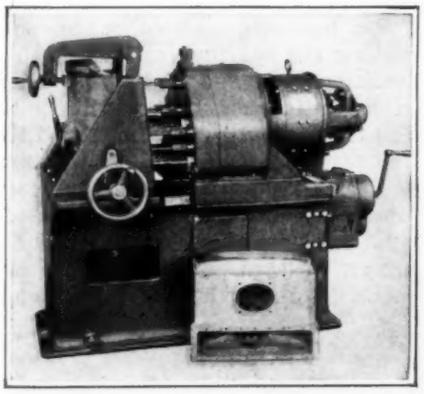


Fig. 1—Greenlee Bros. One-Way 27-Spindle Drilling Machine

standard units. These standard units include frames, head slides, feed boxes and stop mechanisms.

In each case the heads are removable from the slides and are driven by individual motors. The motors may be mounted by substituting an adapter in place of the front bearing spider or they may be secured to supports provided on the slide. When an adapter is used the front bearing of the armature consists of a sleeve gear mounted in ball bearings. All spindles, shafts and gearing in the heads are mounted in anti-friction bearings and are made of heat-treated alloy steel. Ball bearings are used if the center distances permit, roller bearings and ball thrust bearings being used otherwise.

The drill spindles are equipped with taper collets and have 1-in. endwise adjustment to accommodate drills of varying length. A packing

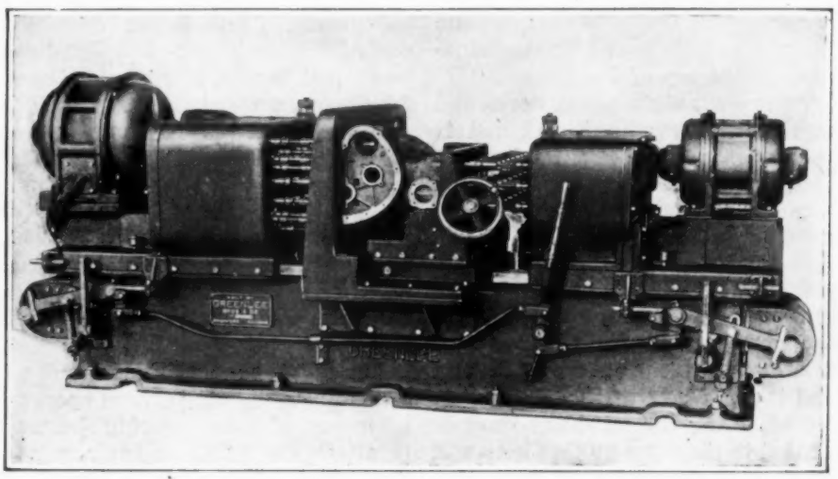


Fig. 3—Greenlee Two-Way Horizont al Tapping Machine

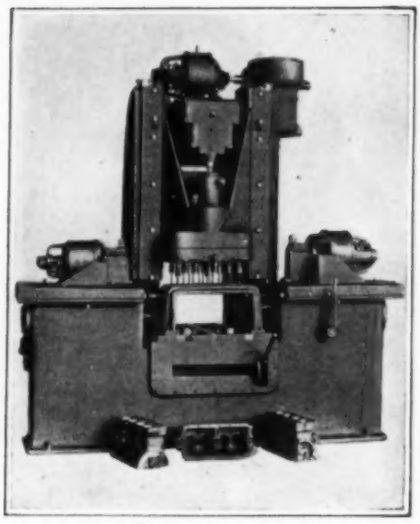


Fig. 4—Greenlee Three-Way Drilling Machine

stop being provided to throw both clutches to the neutral position at the extremity of the stroke. The feed drive has in addition a safety jaw clutch in which the parts are held in mesh by springs. For changing the rates of feed a series of change gears are provided in the feed box, the rate of return of the head remaining constant under all conditions.

The drilling machine illustrated in Fig. 1 is arranged to drill 27 holes simultaneously in a tractor radiator tank. The 27 drill spindles in the head are driven by a 5-hp. motor running at 1,150 r.p.m., three sizes of holes being included in the total number. The shortest distance between spindles is $\frac{7}{8}$ in., the maximum center distance being 4 in. The work is placed in the fixture as shown and is held by three clamps, the finished bosses in which the holes are drilled being securely held against hardened locating pads. An equalizing arrangement causes the pressure on the clamps to be uniform and all clamps are released by the handwheel at the top of the fixture.

A two-way, right-angle, horizontal machine is shown in Fig. 2 and is designed for drilling a total of 15 holes in two faces of an odd-shaped casting. The position of the standard feed box will be noted at the right-hand end of the machine, the feed screw for the left-hand head being driven from the other screw through bevel gears. The vertical hand lever in front of the right-hand head is the feed clutch control lever. For adjusting the left-hand head in relation to the other so that both will complete their cycles at the same time, a worm gear that acts as the feed nut is provided on the left-hand screw. This nut is adjusted on the feed screw by a worm whose shaft extends through the long slot in the frame. The work is located in a fixture and held by two equalized clamp bars.

The two-way horizontal tapping machine illustrated in Fig. 3 is arranged for tapping holes in the top and bottom of an automobile cylinder block. The right-hand head taps the holes in the top, among which are included twenty-two $\frac{7}{16}$-14, one $\frac{5}{8}$-11, two $\frac{5}{8}$-16, and one $\frac{7}{16}$-18 holes. This head is driven by a 10-hp. motor running at 1,160 r.p.m. The other head taps eight $\frac{1}{4}$-20, twenty-one $\frac{7}{16}$-18, thirteen $\frac{5}{8}$-16, four $\frac{7}{16}$-14, twelve $\frac{1}{2}$-13, and one $\frac{1}{4}$-in. pipe tap hole in the bottom of the block, and is driven by a 25-hp. motor.

The gearing in the heads is so arranged that the speed of the spindles is in direct proportion to the pitch of the respective taps, so that all taps will advance at the same rate. Drum-type controllers are provided to reverse the taps and return the heads to their original positions, the controllers being automatically operated by suitable linkage and the segment gears on the front of the machine. When the heads have returned to their starting positions the controllers are automatically thrown into the neutral position. The cylinder block is located on plugs in the central fixture and is clamped as shown in the illustration.

A three-way machine having both horizontal and vertical heads and arranged for drilling the bottom and two ends of a motor cylinder block is illustrated in Fig. 4. The top head is arranged for drilling a total of 17 holes ranging from $\frac{21}{32}$ to $\frac{7}{16}$ in. in diameter and is driven by a 7½-hp. motor. Five holes each are drilled by the right- and left-hand heads and they are driven by 3- and 2-hp. motors, respectively. The horizontal heads are carried between and below the ways on which the slides are mounted. The vertical slide is mounted in opposed V-ways fitted with suitable adjusting gibs. A 3-hp. motor mounted at the top of the machine drives the feed mechanism, the feed motion for the heads being derived from cams.

For adjusting the heads for depth of drilling, adjusting screws operated by means of worm gearing are used to attach the heads to their respective slides. The work is located on pins in a box-type fixture.

Cleveland Portable Grinder and Air Motor

The Cleveland Pneumatic Tool Co., Cleveland, Ohio, has recently placed on the market two portable pneumatic machines that are especially adapted for use in railroad shops and other establishments where a similar line of work is done. These tools are the portable grinder, illustrated in Fig. 1, and an air motor of which Fig. 2 provides an illustration.

The wheel arbor of the grinder is direct-connected to the crank which

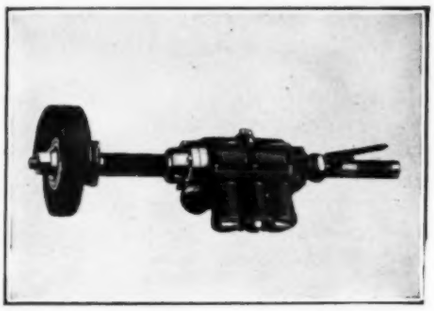


Fig. 1—Cleveland Portable Grinder

rotates at a speed of 4,600 r.p.m. The abrasive wheel is 6 in. in diameter and the complete device weighs 12 lb. The forward arbor extension is covered by a housing which serves as the forward handle. The body of the machine is split on the center line of the shaft bearings so that the entire crank assembly can be removed without disconnecting the pistons or valves from the crank.

Ball bearings are used in the connecting rod bearings as well as the crank bearings and all bearings run in a continuous bath of lubricant. The connecting rods are attached to the pistons by means of floating wristpins that are perforated for lubrication purposes. Four types of throttle valves are furnished, including an enclosed type with inside or outside throttle levers, a straight

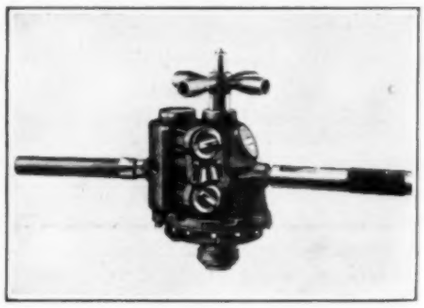


Fig. 2—Cleveland Portable Air Motor

handle with a snap throttle lever, and a straight handle with a twist throttle sleeve.

The air motor shown in Fig. 2 is adapted for such operations as drilling, reaming, tapping, flue rolling, and for setting plain and flexible staybolts, sleeves and caps. The motor is of the four-cylinder type with single-acting pistons. The main valves are of the piston type and are operated by eccentrics on the crankshaft. The valves are located between each pair of cylinders from which they are separated by a thin wall in which large ports are provided.

Ball bearings are used throughout the motor and ample provision is made for proper lubrication.

Gridley 4½-In. Multiple-Spindle Chucking Machine

A machine that extends the adaptability of the Gridley line of automatic multiple-spindle machines into the field of chucking work has recently been placed on the market by the National Acme Co., Cleveland, Ohio. The machine has a 4½-in. chucking capacity and is designed for use on first and second operations on forgings, castings and similar pieces.

The basic design of the Gridley multiple-spindle bar machine is followed in the chucking machine, as far as the nature of the work will allow. The turret arrangement of the former machine is retained and the Geneva-stop indexing motion is also used. This motion is particularly suited to the chucking machine, for the mechanism indexes the work spindle carrier by an intermittently accelerated and retarded motion that gives little shock or strain to the machine in indexing or locking.

The important feature of this machine is the chucking arrangement which is built around the standard air chuck used with the single spindle chucking machine of this line. The three-jaw type of chuck is most frequently used, the jaws being actuated by gear teeth on the short arms of levers whose long ends are connected to a draw bar passing through the spindle. On the rear end of each spindle is mounted an air cylinder, the piston of which is attached to the draw bar. A four-armed spider fastened to the spindle carrier and revolving with it is located back of the air cylinders, and the air hose from the shop air line is attached to the center of this spider by means of a swivel connection.

The valve chambers and valves for the different spindles are located at the ends of the spider arms, as shown in Fig. 2, and are connected by radial ducts to the air connection at the center. From the valves the air enters the spindle air cylinders through swivel connections, located on the spindle center lines and to which the valves are connected through sections of heavy rubber tubing. The valves are of the rotary type and are revolved by small pinions attached to the end of the stems.

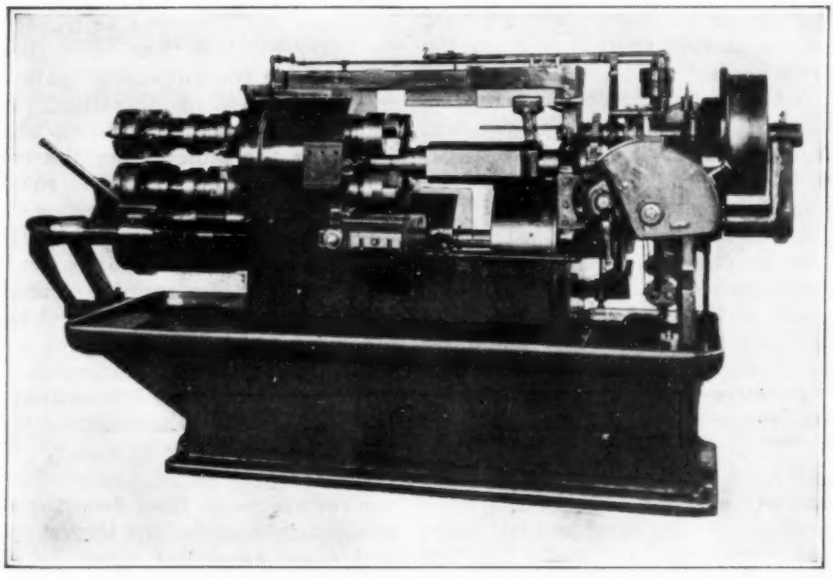


Fig. 1—Gridley 4½-In. Multiple-Spindle Chucking Machine

Plunger racks mesh with the pinions as shown in Fig. 3, the axes of the plungers being parallel to the axes of the cylinders.

The plunger racks are normally held in the rear position by coiled springs, admitting air to the front

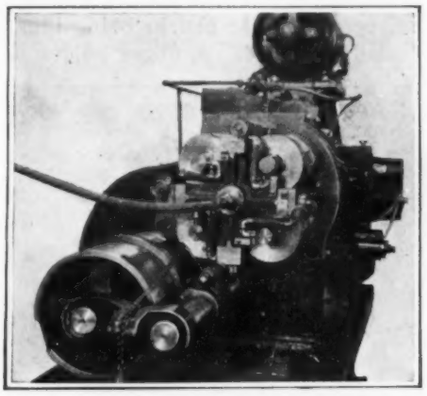


Fig. 2—End view of air chucking mechanism

end of the air cylinders when in this position and keeping the chucks closed. When a spindle is indexed to the loading position the spindle chuck is disengaged by the cam action and the plunger rack for the spindle is pushed forward, admitting air to the rear end of the air cylinder and opening the chuck. The finished work in the chuck is then replaced, the operation of the three other spindles continuing throughout the loading operation.

The spindle remains stationary with the chuck open for a sufficient

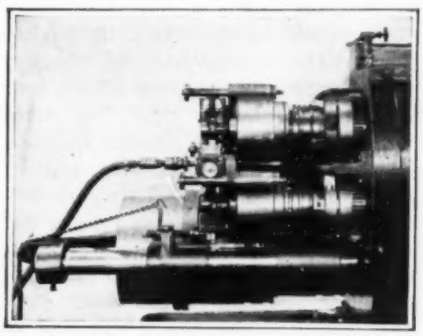


Fig. 3—Side view of air chucking mechanism

length of time for the new piece to be loaded into the chuck, and the action of the cam then closes the chuck and engages the clutch to start the rotation of the spindle. The carrier indexes to the next position immediately after the rotation of the newly-loaded spindle commences. The operating position for this machine is at the rear, so the feed lever is arranged to be manipulated either from the front or the

rear. When setting up the machines the chucks may be operated in any position, the ends of the air valve stems being squared off so that they can be turned with a wrench.

The machine can be equipped with mechanically-operated chucks if desired, the mechanism on the spindles for operating the chucks being illustrated in Fig. 4. A finger holder is

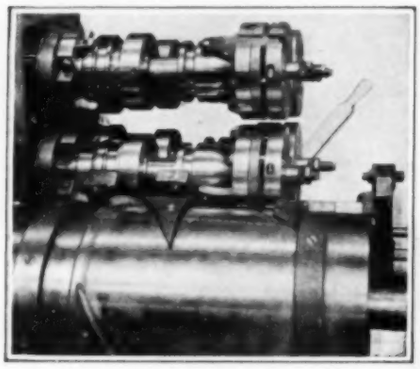


Fig. 4—Spindle equipment for mechanical chucking

mounted on the draw bar behind the end of the spindle, the fingers being operated by an ordinary spool such as is also used with the spindle clutches. The other ends of the fingers bear on a hardened reaction plate mounted on springs so that a cushioning action is provided. This cushioning action is of value when there are slight irregularities in the pieces that are being handled by the machine. The spool that operates the chuck is actuated by cams on the rear drum of the machine.

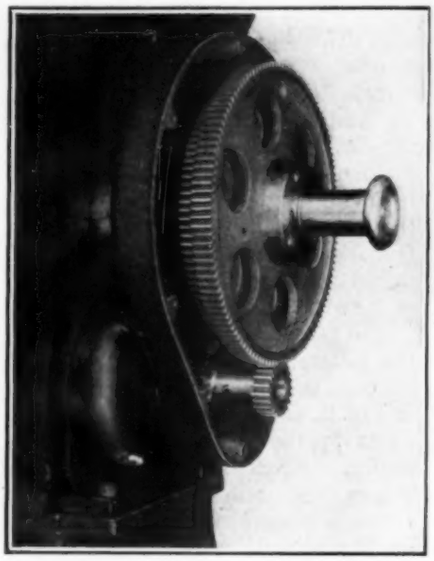
The draw bar is constantly pushed toward the spindle nose by a heavy coiled spring in a pocket at the rear of the spindle, so that the chuck tends to open as the fingers collapse, but a positive opening is assured by a cam-operated slide. This slide carries an arm that presses on the end of the draw bar which extends beyond the finger holder. Adjustment nuts for position of the chuck jaws are also provided upon the end of the draw bar.

This machine has no cross slides in the third and fourth positions but it is otherwise capable of performing the operations of the Gridley bar machine, including threading in the third position. At the fourth position a shelf is placed for convenience in loading and also acts as a guard for the cross-slide drum.

The maximum diameter of chuck that can be used is 6 in., giving a chuck capacity of 4½ in., and in some cases a 5-in. tool feed is available. Special jaw chucks, collets, expanding chucks or expanding mandrels can be furnished as required by the characteristics of the work to be done.

Two-Speed Arrangement for Porter-Cable Bandsaw

In order to make its 20-in. bandsaw available for both wood and light metal cutting, the Porter-Cable Machine Co., 1708 N. Salina St., Syracuse, N. Y., has recently equipped the machine with an arrangement that provides two speeds for the saw. The gearing by which the



Two-Speed Arrangement for Porter-Cable Bandsaw

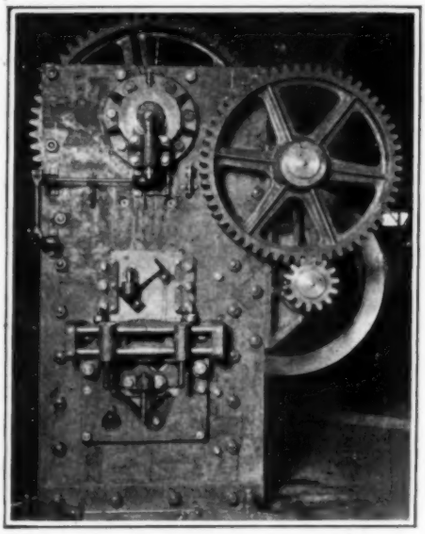
change of speed is obtained is shown in the accompanying illustration and consists of large and small pinions mounted on the motor shaft, together with a double sliding gear on the drive shaft.

When cutting wood the regular saw speed of about 3,000 ft. per min. is used, but if it is desired to cut metals it is only necessary to pull out the knob on the gear case. This operation reduces the speed of the saw by one-half, the change being accomplished by the shifting of the gears in the case. The addition of this device increases the usefulness of the machine, since it can be used for cutting aluminum, brass, hard rubber and fiber, as well as for wood.

The motor that drives the machine is housed in the base, by which it is entirely enclosed. The whole drive mechanism runs in oil and the shafts are mounted on ball bearings throughout.

Buffalo Improved Bar Cutter

The Buffalo Forge Co., Buffalo, N. Y., is now marketing an improved series of bar cutters. A universal bar cutter arrangement is furnished on these machines, the positioning of the plunger counterbalancing springs has been improved, and a



Buffalo Improved Bar Cutter

recently designed drive bearing for the main shaft is incorporated. The plunger and gears are of cast steel, the pinions being made of chrome-nickel alloy steel. All shafts are mounted in bronze-lined bearings, the drive bearings being ring-oiled.

A more positive arrangement for engaging the plunger in the smaller sizes of these machines is made possible through the use of an improved block and ram controlled by a counterweighted lever. The cam adjustment for the jaw type clutches on the larger sizes has also been changed for the purpose of gaining speed and ease of operation. No bolts or nuts need be removed when adjusting the clutch cam, the cam being drawn up against the rollers by means of an accessible capstan nut.

The lower half of the bar cutter section is designed so that it can be used for cutting rounds, squares, angles, flats and tees without changing knives. The upper section contains the knives for cutting structural shapes but these knives are not universal. The machines may be driven either by belt or motor. The cutting capacities of the machines for rounds range from 1-in. for the smallest to 4-in. for the largest size, and other capacities range in like proportion.

News of the Week

Mechanical Engineers Hold Spring Meeting in Cleveland, Ohio

William F. Durand is nominated for the presidency

During the week of May 26 to 31, Cleveland was the gathering point for engineers. The most important of the meetings was that of the American Society of Mechanical Engineers with headquarters at the Hotel Cleveland. From the point of view of the long distance travelers this was the best of the Spring Meetings for enough railroad certificates were turned in to secure the advantage of return fares at half rates.

No attempt will be made here to include details of all the sessions, as many of them had little interest for men in the machine industries. Two sessions were held under the auspices of the Machine Shop Practice Division. The most important paper was the one presented at the session on interchangeable manufacture by A. L. De Leeuw, consulting engineer and consulting editor of the *American Machinist*. It is being printed in full in the May 29, June 5, and June 12 issues of the *American Machinist*. The only disappointing feature connected with Mr. De Leeuw's paper was the small amount of discussion it elicited.

The other paper at this session was on the manufacture of the bolt of the Springfield rifle, by Major Earl McFarland, commanding officer of the Springfield Armory. Major McFarland brought several display boards with him to show the steps in the production of the piece in question. The discussion centered on the gaging problems encountered.

Screw Thread Question

At the other machine shop session the feature was the submission, by L. D. Burlingame, the Brown & Sharpe Manufacturing Co., of the first report of the Sectional Committee on the Standardization and Unification of Screw Threads. It is understood that this report contains what is to be the American standard for screw threads, superseding the various other thread standards in use in this country. In most cases the existing standards have been worked into the new one. The National Screw Thread Commission has still to hold its final meeting, but it is assured that this report will be essentially in agreement with that of the Commission. Manufacturers of threaded products can, therefore, go ahead with the new standard as a basis without fear of further changes or inconsistencies. According to Mr. Burlingame there is still some hope of bringing together the British-Whitworth and the American standards. The angle of the V and the pitch of the thread for ¼-in. screws are the only points of difference that amount to anything.

British Designs

"British Machine Tool Design" was the subject of a paper by W. E. Sykes, consulting engineer, the Farrel Foundry & Machine Co., Buffalo. It was evident from Mr. Sykes' paper that the British designers are paying more attention to the type of tool used in the contract shop than to the production types with which we are more familiar over here. A. B. Cox of the Navy Bureau of Engineering discussed in his paper "Limiting Cases in Involute Spur Gearing." The third paper was by R. H. Rausch, shop superintendent, the Niles-Bement-Pond Co., Plainfield, N. J. He described an interesting application of the sine-bar to the gaging of large pieces.

An interesting paper presented at the session on material handling in industrial plants was the one by M. R. Denison, superintendent of stores division, the Studebaker Corp., South Bend, Ind., on "Material Handling Problems Encountered in the Assembly of Automobiles." Mr. Denison included illustrations taken all the way along the line from raw stock to final assembly and told of inspection methods as well as handling methods.

Other outstanding papers of the meeting were the "Emmet Mercury-Vapor Process," by W. L. R. Emmet, the General Electric Co., Schenectady; "The Protection of Steam-Turbine Disk Wheels from Axial Vibrations," by Wilfred Campbell, the General Electric Co., Schenectady; and the symposium on the "Effect of Temperature Upon the Properties of Metals," presented at a joint meeting with the American Society for Testing Materials. This paper brought out much valuable discussion.

Numerous plant visits were made during the meeting, the more important being those to Nela Park, to the rubber manufacturing plants at Akron and to the works of the National Tube Co., at Lorain. Many of the local plants were also open for inspection, among them those of the Warner & Swasey Co., the National Acme Manufacturing Co., the Lees-Bradner Co., the Ajax Manufacturing Co., the Colburn Machine Tool Works of the Consolidated Machine Tool Corp., and several of the automobile plants.

After the plant visits at Akron a joint meeting and dinner was held at the Portage Hotel with members of the Akron local section. Ex-governor Hartness of Vermont addressed the gathering on "The American Engineering Council," Dean Kimball of Cornell and Dean Ayer of the Municipal University of Akron spoke on "The Engineer in Politics," and an address of welcome to the new student section at the local university was given by Mr. Gamling of the Cooper Union Student Branch. President Low also welcomed the new student members and they were all introduced to him.

What was planned to be the big evening event of the meeting failed to come up to expectations. The subject was "Industrial Preparedness," and prominent speakers had been secured. Two of them unfortunately, Bernard M. Baruch and former Secretary of War Newton D. Baker, were unable to attend. Mr. Baker had to appear as counsel in a lawsuit and Mr. Baruch had a bad cold. He came to Cleveland but was too sick to speak and his address was read by Benedict Crowell, formerly Assistant Secretary of War. Dwight F. Davis, Assistant Secretary of War, was on hand and gave his usual good talk on industrial mobilization, much along the lines of the article contributed by him to the *American Machinist* some months ago. Frank A. Scott, president of the Warner & Swasey Co., presided and General C. C. Williams, Chief of Ordnance, made a short speech.

The Committee Meetings

Many important committee meetings were held. Those of interest to machine shop men included a session of the Special Research Committee on Cutting and Forming Metals at which plans were made for some work to be done during the coming summer. The Tee-slot sub-committee of the Sectional Committee on Small Tools and Machine Tool Elements made considerable progress. The Sectional Committee on Plain Limit Gages for General Engineering Work met and was to have submitted a report, but a conflict of meetings interfered and it will appear later in some one of the society publications.

Announcement was made that the Spring Meeting of 1925 will be held in Milwaukee, Wis. The nominating committee evidently had less trouble than usual in coming to an agreement as it brought in its report on Wednesday. The slate follows: President, William F. Durand, Prof. M. E., Stanford University, Calif.; Vice-Presidents: Robert W. Angus, Prof. M. E., Faculty of Applied Science and Engineering, University of Toronto, Toronto, Canada; S. F. Jeter, Chief Engineer, the Hart-

ford Steam Boiler Inspection & Insurance Co., Hartford, Conn.; Thomas L. Wilkinson, Consulting Engineer, Davenport, Iowa; Managers: John H. Lawrence, Engineering Manager, Thos. E. Murray, Inc., New York; Edward A. Muller, vice-president and general manager, the King Machine Tool Co., Cincinnati, Ohio.; Paul Wright, Paul Wright & Co., Birmingham, Ala.; Treasurer, William H. Wiley, president of John Wiley & Sons, Inc., New York.

Delegates to the American Engineering Council are: W. F. Durand, Stanford University, Calif.; William P. Hunt, president of the Moline Tool Co., Moline, Ill.; I. E. Moultrop, assistant superintendent Construction Bureau, The Edison Electric Illuminating Co. of Boston, Boston; E. N. Trump, President the Strumpf Una-flow Engine Co., Syracuse, N. Y.; William W. Varney, Attorney at Law, Baltimore, Md.; Ira Dye, Industrial Engineer, Seattle, Wash.; W. S. Finlay, Jr., vice-president of the American Water Works & Electric Co., New York, N. Y., and Dean E. Foster, Consulting Petroleum Engineer, Tulsa, Okla.

New Trade Lists for Machinery Exporters

The Commercial Intelligence Division of the Department of Commerce has just announced a series of new trade lists of interest to exporters of machinery. These lists contain the names of importers and dealers in machinery in foreign countries and may be had without charge from any of the district or co-operative offices of the Bureau of Foreign and Domestic Commerce or from Washington.

In addition to the periodic compilation of trade lists of foreign dealers in machinery, the division has on file detailed sales data on more than 100,000 foreign firms and individuals with which American firms do business. More than 1,000 American trade representatives stationed abroad co-operate with the division in keeping this data up to date.

As there exist at the present time many potential foreign markets for American machinery, exporters of this commodity are especially invited to use the service of the Division of Commercial Intelligence.

In applying for the new trade lists, use number and file as follows:

British Malaysia	FE—18005—C
Chile	LA—13024—A
Ireland	BE—3014
Italy	FUR—6014—A
Netherlands East Indies	FE—19007—G
Peru	LA—20019—A
El Salvador	LA—29021
Venezuela	LA—22022

Auburn University Adds Engineering School

Officials of Auburn University, at Auburn, Ala., have announced plans for construction this year of a $250,000 Engineering building, made possible by a $100,000 donation by Erskine Ramsey, Birmingham capitalist. It will be known as the Ramsey Engineering building, with a capacity for 700 engineering students.

Ethan Viall Resigns As Ohio Editor

Ethan Viall, Ohio Editor of the *American Machinist*, has tendered his resignation, effective June 1, on account of poor health. He will continue to reside at 7474 Lower River Rd., Fernbank, Cincinnati, Ohio.

Mr. Viall has been connected with the *American Machinist* since Jan. 16, 1911, with the exception of two years, 1920 to 1922, when he was managing the plant of T. W. Minton & Son, Barbourville, Ky. For four years, beginning in 1913, he was Western editor, with headquarters in Cincinnati, after which he returned to New York where he was made managing editor in 1917. He became editor-in-chief in 1919 and resigned in 1920. In 1922 he became Ohio editor.

Japan Third Largest Machinery Buyer

Although American exports of industrial machinery to Japan declined about $2,500,000 in 1923, Japan stands third among the countries of the world as a market for American machinery, says the Industrial Machinery Division of the Department of Commerce. In 1910 Japan was tenth on the list. The following table gives the 1923 ranking:

Canada	1	$27,371,084
United Kingdom	2	14,517,848
Japan	3	11,832,100
Cuba	4	8,253,402
Mexico	5	7,827,323

The greatest decline in 1923 occurred in the power-generating machinery classification which fell off approximately $1,000,000 under the 1922 figures. Metal-working machinery showed a slight increase, while mining, oil-well, and pumping machinery showed a gain of over $300,000.

Outline of Study for Welders

The educational committee of the Gas Products Association of Chicago, has prepared an outline of instruction in oxy-acetylene welding covering twenty-four lessons and twenty-four shop exercises, furnishing lecture topics, suggestions for shop work and examination questions. Schools using the equivalent of this course are placed on the "accredited list" of the association and are given co-operation by representatives who are located in all large industrial centers. Students are secured for these schools and later jobs are secured for the students. The services of a large group of welding experts are put at the disposal of the instructors.

The Gas Products Association recently announced that copies of the course of instruction recommended for "accredited schools" could be obtained by individual firms who wish to train their own welders in a systematic way. The services of the educational committee are also at the disposal of the supervisors of such welding departments. The committee can render valuable assistance in developing a system of apprentice training for the welding department. It has also been suggested that in cases where individual firms do not employ a sufficient number of welders to justify class work several firms in a particular city can arrange to have training furnished in a local trade school.

Many People See Navy Aviation Exhibit

The growing interest in aviation was clearly shown on May 31 when over 100,000 people went to Lakehurst, N. J., to see the aerial demonstration of the Navy. Automobiles from a radius of 100 miles choked the roads and thousands of them finally found parking space within the grounds.

All sorts of aircraft took part in the demonstration in spite of a heavy wind blowing all day. A free spherical balloon, with three people in it, sailed over a corner of the huge hangar of the Shenandoah and had to come down to prevent going out over the ocean. The giant Shenandoah swung all day from her mooring mast like a huge weather vane or wind cone, and finally took the air about 4 o'clock with a few passengers for a flight.

Her "baby sister," the non-rigid J-1, was in the air several hours and made a fine landing in the face of a strong wind, while an observation or sausage balloon was moored in the background and showed by her antics, the force and freakishness of the wind.

Planes of various kinds from small, fast scouts to twin-motored Martin bombers flew in formation and did stunts which showed the wonderful control the modern aviator has over his plane, one man flying through the huge hangar. There were parachute jumping, bomb dropping and other interesting exhibitions.

A noteworthy feature of the day was the lack of officiousness on the part of the navy officers and men in handling an unprecedented and unexpected crowd. Nothing shows the advances in aviation more than the carrying on of all kinds of flying in such a wind without an accident to any participant.

Power Peak Load Study in Pennsylvania

Governor Gifford Pinchot of Pennsylvania has named O. S. Beyer of New York city, Morris L. Cooke, C. J. Russell and James Rawle, of Philadelphia, and G. M. Gadsby and R. C. Bergvall of Pittsburgh, all engineers, to gather and study data relative to peak loads in connection with the State's giant power survey. Mr. Cooke is head of the survey, which was authorized under a recent act of the Legislature.

Colburn Works Moved to Rochester

The Consolidated Machine Tool Corp., announces the transfer of its Colburn Works now at Cleveland to its Betts Works at Rochester, N. Y. This move is made on account of the large economies of operation thereby possible.

Gradual Improvement in French Industries

American machinery and machine tools gaining favor with big industrialists—The labor situation—American patents and French corporations—Exports and imports

By Our Paris Correspondent

DUE mainly to the instability of the franc—a too rapid recovery, say certain big manufacturing interests who largely sell their products abroad, to whom the low valued franc gave a certain advantage in many foreign markets—the French metal working trades in many specific instances are suffering from a stagnation which threatens to develop into a stalemate over a more or less extended period.

The value of the franc appears not yet to be stabilized, as it increased a franc to the dollar during the past week alone. If this makes it easier for the buyer of Cardiff coal or the importer of American tools or machinery, automobiles and other products, it is the more difficult for the French manufacturer to sell abroad cast iron pipe, textile machinery, the stampings of the small metal industries of the Ardennes and above all pig iron for transformation, which both Belgium and France were able to sell in the United States during the recent debacle of the franc.

Numerous and well-authorized opinions in a like sense have been expressed latterly by French bankers, exporters and manufacturers. That they are "interested parties" does not in the least influence the value of the argument. This is, however, but one phase which is the opposite of that which the nation at large expresses.

American Automobiles

Actually American automobiles imported during the first two months of the year were double in numbers of those of 1923, due to a matter of price and efficiency which is made apaprent by the January figures alone wherein of 2,406 units imported the United States contributed 2,351. It is purely a question of American manufacturing methods, the supremacy of automatic and semi-automatic machinery as compared with the human controlled machine tools so commonly in use in France. It is this known fact which has built up the great business in France of such firms as Fenwick Freres, the Allied Machinery Co., R. S. Stokvis & Zonen, the Ingersoll-Rand Co., the Sullivan Machinery Co. and others.

With respect to foundry machinery it is interesting to know that the new foundry equipment to be laid down by the Citröen automobile plant is to be entirely of American manufacture—a victory of compressed air over hydraulic power of the moulding machine department, the foundry building in itself being designed by an American foundry engineer; a wide swing about from the days when Citröen was quoted in the public press as disdaining American methods and not fearing American competition.

There is still a considerable distrust of the workings of the eight-hour law which has been in operation since 1920 and various French regional industries are asking for a more liberal interpretation of exceptions to the ruling while the whole country views with alarm the possibility of Germany abrogating the law entirely as was recently hinted at the meeting of the International Labor Bureau which was presided over by a Frenchman, a former member of the cabinet.

Trust Expanding

The Franco-Belgian Metallurgic Trust, in which are concerned some of the more important metallurgical firms of north France, is raising its capital from 13 million francs to 22 million francs which seems to point to the fact that its operations in foreign markets are to take on more amplitude than previously. The trust furthermore specializes in railway equipment and one unit announces orders in hand for 150 million francs for delivery during the present year. Competition between Belgian and French firms has thus to some extent been eliminated and a close corporation of interest formed which at least is an interesting experiment whether it endures or not.

A new phase of the metal trades has opened up since the war in the manufacture and supply of replace parts for American made agricultural machinery now so commonly found in France, the same being true to apply at least to one automobile. The trade is doubtless legitimate, but it must cut into the American product to some extent, provided manufacturers of such consider that it is their province to supply parts as well as the original machine.

A curious commentary has just been made in a prominent political journal to the effect that France should no longer be tributary to the foreign manufacturer of agricultural machinery, pointing to the fact, as claimed, that such American product is in general inferior in finish and efficiency to that produced in France. One would have thought the contrary to be the case and can only put the observation down to a minor aspect of political electioneering, above all since it ignores the worth of the American Harvester Co.'s output manufactured in France at Lille. A campaign such as this in dangerous and may well be taken to heart as an exhibition of the mental attitude of French law makers toward all foreign product at the present time. As a final blow the critic in question stated that America had presented very little in the line of agricultural machinery which was suited to use in France above all to being operated by the French workman. French exports of this specialty, it may be mentioned, are picking up. From 1920 when only 5,700 tons were exported to 1923 when 8,500 tons went abroad is a satisfactory enough showing when it is compared with imports of 37,831 tons and 23,400 tons respectively in the same years, in one instance (exports) an increase of sixty per cent and in the other (imports) a decrease of virtually the same.

There have been a number of recent efforts, at least investigations, looking to the establishing of American mechanical industries in France. The Delco patents are now being worked and manufactured successfully here, the Wellman-Seaver-Morgan Co. product of Cleveland is being duplicated at the Schneider plant in mid-France, and there are others.

One thing ignored by many who are thus seeking to overcome high duties and a low valued franc is the law relating to the establishment of corporations in France. Shareholders are required to the number of seven but may reside anywhere, each being possessed of at least one share and at least one quarter of the capital must be paid up at the time of organization. The International Corporation Co. has issued a valuable booklet referring to the formation of French companies under the title of "Formation of Business Corporations under French Law and the Licensing of American Companies in France." This refers to the French Société Anonyme, the counterpart of the American corporation.

Labor Conditions

The labor situation remains satisfactory. More and more ordinary labor is being called for as industry takes a spurt, which undeniably it has since the war. Fluctuations in trade conditions brought about by the political status of the present as well as the financial pyrotechnics of the past few weeks have brought little diminution in the labor demand, and now with the height of the agricultural activity approaching there is seemingly not enough to go round. Under such circumstances it is not difficult to transplant labor regionally as needed. The frontiers are still opened wide to the import of Italian, Spanish, Polish and Belgian labor which chooses to come, and a recent week's demands for workers of various categories to the numbers of 11,300 was met forthwith by the Bureau of Immigrant Labor to the extent of ten thousand odd.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance*, New York

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LOOKING back over the newspapers of this time a year ago we find that the statements and predictions which were then being made about business were astonishingly like those being made now. Some of the diagnosticians had discerned signs of weakness and had frightened us with their warnings, but they were soon proved to be wrong, the country caught its second wind during a period of comparative quietness which followed the record-breaking spring, and fall business was all that most people desired. The truth is that we were then, as now, benefiting by the necessary relaxation which must always succeed the perfervid activity of a "business peak." To those who live on excitement this relaxation is generally unwelcome and since they are the most vociferous their complaints drown out the optimistic expressions of the great majority who "keep on sawing wood" and accept with equanimity the fact that business, like a man or a machine, must have its rest periods.

The facts indicate that there is now even less reason to fear an important decline in business than there was a year ago. Briefly summarized the essential barometric indicators for the two periods compare as follows:

The population of the country is 1,400,000 greater and our exports for the first four months of the year exceeded those of last year by $140,000,000, even at lower prices. The market that this country is supplying both within and without its borders has increased to that extent and the "excess producing capacity" of which so much is made has been correspondingly reduced.

All the indicators show that the domestic consumption of goods has fully kept pace with last year, despite the complaints of unseasonable weather and of distress among the farmers. Early spring retail distribution as estimated by the Federal Reserve Board is 2 per cent greater than last year, and chain and mail order stores show an even larger increase. Bank clearings last week were 4 per cent over 1923 and the value of checks cashed during the same period was 3 per cent greater. The number of freight cars loaded during the first quarter made a new high record, slightly exceeding last year's figure, and though they have latterly been running behind they are now gaining, and authoritative judges believe that with the usual fall increases they may yet make new records.

Figures of industrial production for the first quarter of the year show varying increases and decreases, but the sum total is probably not far from last year. The bituminous coal output was 162 million tons compared with 177 million a year ago. Stocks were accumulated last winter in preparation for a strike which did not occur, but they have now been virtually absorbed and the bituminous dealers look for excellent business during the remainder of the year.

The oil output was 171 million barrels as against 157 million in 1923. Since this heavy production had to be added to already large stocks prices may have to decline further to help check it, but consumption will be enormous this summer and oil is too volatile to say with safety that it is going down.

The combined iron and steel output was only 800,000 tons less than in the first quarter a year ago and signs have been apparent in the past two weeks that better markets are opening up.

The output of electrical energy during the first three months of 1924 was 15 billion kilowatt hours, compared with 13.8 billion in 1923.

Cement production during the first quarter was two million barrels in excess of last year and the lumber cut was 100 million board feet greater, but since 6.5 per cent more building permits were granted these figures do not indicate an overproduction, though a slackening in building during the remainder of the year is to be anticipated.

Automobiles manufactured during the first quarter totaled 1,309,062, compared with 1,143,154 in 1923. Since caution now rules the industry this increase may not be maintained, but apparently the output will not be much below last year.

Production of shoes and cotton, woolen and silk goods has been uniformly lower than in 1923, but no pronounced decline in consumption has been evident and the stocks on hand are in most cases much smaller.

None of these figures justify either current tales or expectations of a business depression. The industries which have been unusually active may show a falling off because their stocks are large, but those whose output has been low will become more active because their stocks are small.

The money markets offer a much greater inducement to enterprise than they did a year ago. The outstanding commercial loans of banks are but a trifle above last year and the resources behind them have increased relatively much more. The best commercial paper is now salable at 4 per cent compared with 5 a year ago, and the reserve ratio of the Federal Reserve Banks is 8 per cent higher, while gold is still flowing to this country and savings deposits are larger virtually everywhere.

What's Doing in Industry

May business in the machinery and machine tool trade was about equal to that of April, but behind the business as done last May or April. The two months have been disappointing and inquiries have fallen off as well as orders. June will probably be quiet, although dealers in some parts of the country believe that improvement will be noted over the two preceding months.

After a decline of several weeks, the iron and steel industry expects an increase in business and predictions are that June will be much better than April or May.

Automobile production has not improved as much as was expected although May will probably show greater output figures than April, but June is not expected to be any too busy unless the unforeseen occurs. Close students of automotive conditions say that the total figures of the year will be as great as 1923.

Industrial building showed an increase in May as compared with April but it was seven million dollars less than May, 1923.

Electrical goods manufacturers and makers of big electrical equipment are still doing a good business, reported by some as ahead of last year.

General business has been lifeless and while merchants are complaining, statistics show that the volume of trade has not been as small as it would seem.

The bond market has been steady while the stock market has been dull with but little trading, no appreciable changes in prices, but with indications of a slow steady upward trend from now on.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

The machinery and machine tool market in the New York district were best characterized as listless last week. Whether it was due to politics, pre-holiday spirit or simply a general curtailment in buying could not be determined. Outside of some sales to the big electric companies, a few sales of necessities to railroads and general industrials, dealers report a quiet week. Automobile plants in the East are not buying machine tools. Whether they are producing cars or not cannot be definitely learned as conflicting reports are to be heard from various shops.

Inquiries fell off during the week which is the barometer that most dealers watch closest. This presages a dull June and possibly July, according to machine tool men.

May compares favorably with April, most dealers saying that the totals were about the same. But May compared with May a year ago shows that there has been a definite decline.

U ed tools are not finding hard sledding as the demand has been quite brisk and sales have not been hard to close.

Canada

The machine tool business in Canada, like most other lines, is undergoing a period of readjustment necessitated by the recent budget changes, and indications are that for a time, limited buying to cover current demands will continue. There has been a fairly active call for general repair work in machine shops and industrial plants, but otherwise there has been no marked improvement in demand.

Steel producers are somewhat more active in Ontario, but there has been a slackening in the Maritime provinces as a consequence of the lower duties on steel and iron to be used in the manufacture of farm equipment. The president of the Steel Co. of Canada takes the view that the outlook in the industry is regarded with more confidence generally and that business is likely to pick up. The production of motor cars also has declined somewhat, but this is not at all significant, since the output for the first four months of 1924 was far above any previous record for the same months. When a comparison is made with a normal rather than an unusually active period, the present rate of output is satisfactory.

Manufacturers of farm implements have just announced the list of reductions which have been made as a result of the tariff changes and the decrease in the sales tax. According to advices from one of the largest firms, the maximum reduction on any implement is $18. An effort is now being made to secure a reciprocal trade arrangement with Australia, particularly in regard to a preference on agricultural implements from Canada.

During the last two weeks Parliament passed bills providing for the construction, on a three year program, of 1,000 miles of branch lines for the Canadian National Railways at an estimated cost of $27,000,000. The bills are now before the Senate where it is possible several may be eliminated, but it is practically certain that construction work will be commenced this year on the majority of the lines.

Delivery has just been made by the Canadian Car & Foundry Co. to the Toronto, Hamilton and Buffalo Railway of ten all-steel, first class coaches, six all-steel baggage cars, and six all-steel smokers. This company has received an order from the Algoma Central & Hudson Bay Railway for 50 ballast cars. The Globe Furniture Co. of Waterloo, Ont., announces that it is in the market for equipment for a foundry and machine shop.

Southern District

Though machine tool trade among Southern dealers still is a little quiet, May proved better than April, and also showed a fair improvement over May, 1923, with most larger dealers confident June business will be still better due to steady improvement noted by the South's leading industries recently.

The textile mill outlook is much brighter than in the past two or three months, and though orders have not picked up to any extent as yet, the trade looks for much better business in June. Inquiries are a little larger than they were, and dealers are going after this trade more actively than they have since the textile mills began to curtail early in the year.

Sales to garages and service stations also are picking up steadily, mostly in used equipment, with the trade reporting as active a demand from this source as in several months, in light and heavy equipment, the latter principally drill presses, lathes, etc.

Not much business is reported with smaller machine shops, though demand is expected to take a turn for the better in the next two or three weeks.

Demand from road builders for heavier equipment continues very active, with the outlook the best it has been in years. Virtually all Southern states have increased road building appropriations this year, and active construction is now under way over the district.

Another industry buying actively right now is the brick manufacturing principally equipment for several new plants that are being constructed in various sections of the Southeast. Inquiries are heavy for both new and used equipment from this source.

Railroads are buying on about the same basis as last month, with indications that sales to this industry will continue active through the summer months.

Export shipments out of Southeastern ports continue about the same, the trade looking for June export business to prove equally as good as May, and continue fairly steady through the summer.

Detroit

Many inquiries but fewer orders than has been anticipated is the experience found by machine tool and machinery leaders in Detroit and vicinity.

Tool shops are finding the sledding a little harder during the latter days of May than during the fore part of the month. Manufacturers making small cutting tools such as reamers are very anxious for business, while others making jigs and fixtures have found considerable business.

More activity is in sight for the next two or three weeks, leaders in the field assert, and they point favorably to the fact that Detroit has not experienced the slump that has attended other centers.

A material increase in truck production in proportion to the total motor vehicles manufactured is noted during the past month.

Railroad business appears to be off from 10 to 15 per cent. but settled conditions within a few weeks are expected to result in material improvement.

Indianapolis

A slight difference of opinion as to the volume of business being done is noticeable in this territory. Some machinery men say business is quiet while others say it is good. With those manufacturers and dealers specializing in public utility machinery, the situation is better than it has been for some time. It appears many of the public utilities are making some purchases. One Indianapolis dealer who handles considerable of this equipment, said that he had done more business the first four months of the present year than in the first six of last year. This is a sizable increase in volume, but the rank and file of the machinery trade do not make this sort of a report.

For example, the last month has seen a further slump in demand for flour milling machinery. The flour mills have little market for their product and are spending as little as possible for replacements or new equipment. The same holds true of the coal mine ma-

chinery business. Some of the mines are buying some tools and metal working lathes and some small machinery, but the volume is not large. Almost the same story comes from the manufacturers of machinery dealing with the woodworking industry.

Milwaukee

The lull in the demand for machine tools and general metalworking equipment continues in effect, although there seems to be nothing new arising to create any disturbance or to accentuate whatever apprehension has been felt over the decline in sales for the past sixty days. Business admittedly is very quiet, and the outlook is generally regarded as one that will produce no marked changes in the characteristics of demand until early fall at least, according to authorities who have given the situation a thorough analysis.

While manufacturers of passenger automobiles and of units, parts, materials and accessories, are in a better position with respect to production, due to the stimulus experienced in sales to the consumer, their requirements of new machinery remain confined to strictest necessities. Existing capacity appears to be entirely adequate to accommodate all demands for production for the present, and about the only purchases the factories are making are for necessary replacements or to secure machines of greater efficiency and higher production than those now used.

Railroads are buying very sparingly, and the two lines maintaining shops in Milwaukee and elsewhere throughout Wisconsin have done considerable retrenchment since June 1.

The picture is not discouraging throughout, however. While the manufacturers of machine tools are getting but a small run of orders, generally for one or two items at a time, the dealers in this market say they did better in May than in April, and sales have been improving.

Auto Production in Canada in 1923

The production of motor vehicles in Canada during 1923, according to a bulletin just issued by the Bureau of Statistics, exceeded all previous records and reached a total of 147,582 valued at $97,369,814, as compared with 101,007 in 1922. Included in the foregoing total were 380 trucks valued at $755,638 manufactured by firms whose main products were not motor vehicles, but as other statistics pertaining to the manufacture of these trucks could not be proportioned, the statistical review of the industry covers only those concerns producing motor vehicles as their major product. The value of the production by the industry proper in 1923 was $96,614,176 and while this was 18 per cent greater than in 1922, it did not come up to the total value of the 1920 production of $101,465,846. Service and service parts included in the 1923 total were valued at $9,390,793, while the same item in 1920 amounted to $12,754,125, leaving the value of motor cars made in the automobile industry in 1923 at $87,223,383, and in 1920 at $88,711,721.

Vauclain Gets Orders from Mexico

Samuel M. Vauclain, president of the Baldwin Locomotive Works, has returned from an extended trip to Mexico with contracts for $2,000,000 worth of business from the Obregon Government.

"Mexican finances are improving steadily," Mr. Vauclain said. "I wish we could extend more credit to Mexico. The work of Ambassador Warren for American interests deserves much praise. Banditry and other forms of lawlessness are almost extinct in Mexico City, where it is possible now to transport gold bullion through the streets without armed guards. President Obregon has brought peace, prosperity and a sound government to Mexico."

Obituaries

W. T. WOOF, for many years London machinery manager for Alfred Herbert Ltd., died recently.

GEORGE H. KISTLER, aged 37 years, superintendent at the Standard Steel Car plant, Hammond, Ind., died recently at his home in that city.

STEPHEN OLIN JOHNSON, founder of the Employers' Association, and for years a leading manufacturer of Detroit, died May 19 at Los Angeles, Calif., at the age of 76 years. Together with William Penberthy and Homer Pennock he founded the Penberthy Injector Co.

Business Items

The Meachem Gear Corp., Syracuse, N. Y., has taken over the plant of the Weeks-Hoffman Corp., in the same city and it is understood will produce gears for automobile service and repairs. The officers of the Meachem corporation are: T. G. Meachem, president; J. F. S. Meachem, vice-president and treasurer; George W. Wood, secretary.

The Axle Bearings Corp. of New York has been organized for the manufacture of axle-roller-bearings for horse drawn vehicles. The Teetsow-Drysdale Engineering Corp. will supervise the promotion and commercial exploitation. Operations will start about Oct. 1.

The Newark Wire Cloth Co. is now established in its new plant, 351-365 Verona Ave., Newark, N. J.

Samuel T. Freeman & Co., auctioneers of industrial plants, will move July 1 to their new building, 1808-1810 Chestnut St., Philadelphia. The firm has been located for sixteen years at 1519-1521 Chestnut St.

The Warner G. Smith Co., manufacturer of foundry supplies, has decided to locate its Canadian branch in Hamilton, Ontario, and is now applying for incorporation of the Canadian company.

A syndicate of Birmingham, Ala., business men has purchased the plant and properties of the Preston Motors Co., of that city, which went into bankruptcy about two years ago. The company manufacturers the Premo Car. The price paid by the syndicate was about $200,000, no definite announcement having been made as yet regarding the future of the plant.

The Pittsburgh Testing Laboratory announces the occupancy of its new building on Stevenson St. at Locust St., Pittsburgh.

The executive offices of the Ohlen-Bishop Co. have been moved from Columbus, Ohio, to Lawrenceburg, Ind.

The American Flexible Wheel Corp., Cincinnati, will erect a large plant for the manufacture of a patented wheel for automobile trucks. The company has been incorporated by Gerson J. Brown, Edgar S. Freiberg, and Samuel Loid. The capital of the company and the location of the plant have not been made public, but the incorporators plan to erect a plant that will provide wheels for distribution centers in all parts of the country.

Personals

EDWARD A. MULLER, vice-president and general manager of the King Machine Tool Co., Cincinnati, Ohio, has been nominated for membership on the board of managers of the American Society of Mechanical Engineers.

S. J. SMILEY has been elected president of the Duplex Machine & Tool Co., Alma, Mich.; Ezra L. Smith is vice-president; Glenn S. Crisp, secretary-treasurer. These officers and O. W. Hayes, John D. Sullivan, George Meldrum and Charles J. Wesch make up the board.

E. S. EVANS, president of E. S. Evans & Co., Detroit, Mich., becomes vice-president in charge of sales of all units of the Bassick-Alemite Corp.

JAMES ZEDER, former service engineer of the Timken Roller Bearing Co. of Canton, O., has joined the Chrysler Motor Car Co., Detroit, Mich.

A. W. HUGHES has been appointed Canadian manager of the Cleveland Pneumatic Tool Co. of Canada, in succession to C. D. Garner who has been made manager of the Detroit office of the company. Mr. Hughes was for six years assistant to Mr. Garner.

R. K. BLAIR of Buffalo, has become president and general manager of the Engineering & Machine Works of Canada, St. Catherines, Ont., following the death of the former president, S. W. Jencks, Albert E. Jencks, brother of the late president, becomes vice-president, succeeding Col. H. R. Fraser, also deceased.

GEORGE A. LEITHNER has been appointed district manager of the Car Service Division of the American Railway Association, with headquarters at San Francisco, Calif., effective on June 1.

T. T. IRVING, chief engineer of the Canadian National Railway lines west of the St. Clair River, has been appointed chief engineer of the Central Region with headquarters in Toronto. Mr. Irving succeeds Major F. L. C. Bond, who was recently transferred to Montreal upon being appointed general superintendent.

A. R. DAVIS, works accountant for the Walworth Manufacturing Co., Boston, addressed the Western Massachusetts chapter of the National Association of Cost Accounts at their annual meeting in Springfield, May 27.

DOUGLAS ANDREWS has been appointed sales director of the Westcott Motor Car Co. of Springfield, O.

SAM V. HARDING has been appointed service manager of the Columbia Motors Co., Detroit.

THOMAS STOKER of the Elswick Works of Sir W. G. Armstrong, Whitworth & Co., Ltd., Newcastle-upon-Tyne, England, will arrive in Montreal in the near future, having been appointed to take general charge of the firm's Canadian business.

C. R. SCHULER, during the last nine years chief engineer of the Midwest Engine Co., Indianapolis, has become sales engineer of the Hinkley Motors, Inc., Ecorse, Mich.

J. W. ORROCK, has been appointed engineer of buildings of the Canadian Pacific Railways.

DANIEL E. PARKER, formerly manager of the Main Belting Co., Montreal, has opened an office at 422 St. James St., Montreal, where he will operate under the name of the Dan E. Parker Belting Co.

Tells of Progress of Pressed Metal

Douglas P. Cook, president of the Boston Pressed Metal Co. of Worcester, Mass., addressed a dinner meeting of the New Britain Branch, A.S.M.E. at the Connecticut State Trade School in New Britain on the evening of Thursday, May 22.

Mr. Cook's subject was "Pressed Steel Engineering"; being a part of the paper read by him before the New York society in December. In the course of his remarks the speaker directed the attention of his audience to the numberless instances in which pressed metal parts are taking the place of gray iron and brass castings, die-castings, and in many cases even of screw machine products. He showed how the substitution had brought about reduction in weight, increase in strength and saving in cost of machining, as well as adding to the symmetry of design.

The talk was illustrated by slides, each one showing a part made of pressed steel and the casting or screw-machine part it had superseded. A motion picture was also shown, exemplifying in action the many intricate drawing, swaging and stamping operations that go to make up a complex part of sheet metal.

Illinois Central Plans Many Improvements

Including the $14,729,500 expended in the first four months this year, the Illinois Central R. R. will spend approximately $32,000,000 in improvements during 1924, according to a statement made by C. H. Markham, president.

"Completion of some of the projects and the receipt of some of the equipment authorized last year have been extended into the current year," he said. "In addition, we have started some new improvement work. The last of the equipment ordered last year has recently been received and no additional orders have been placed."

He pointed out that the railroad was in very good condition so far as equipment was concerned, and that the additions made last year would take care of the needs of the company this year.

"Among the more important improvements started this year," he explained, "are the enlargement of terminal facilities at East St. Louis, improved mechanical facilities at Dubuque, Iowa, and the construction of new freight and passenger facilities at Baton Rouge, La."

Trade Catalogs

Gears and Speed Transformers. The William Ganschow Co., 1001 W. Washington Boulevard, Chicago, Ill. General catalog No. 100 has been recently issued by this company. It is properly called a handbook, containing 316 pages and being bound in flexible leather. Besides illustrations showing the companies product in use and in detail, the book contains many valuable tables of gravity and weights, pitch diameters, and characteristics of gears. The formulas and specifications contained make up an excellent study for men interested in gears and speed transformers.

Mechanical Tools. The L. S. Starrett Co., Athol, Mass. Catalog No. 23 covering nearly all of the products of this nationally known company has been mailed out to the trade. Rules, rule holders, steel tapes, squares, gages, calipers, micrometers, hand vises, and other tools made by Starrett are listed, described, illustrated and priced.

Brass. The Chase Metal Works, Waterburg, Conn. "How to Order Brass" is the title of a new booklet that has recently been published by this company. Its importance can readily be seen from the title and the reading matter lives up to phrase in every sense of the word. The work is really designed to aid purchasing agents in obtaining the best possible brasses. Illustrations aid the text in making clear the subject.

Head and Eye Protection. The American Optical Co., Wellsworth Division, Southbridge, Mass. The many styles of masks and goggles for every use in the industrial plant are shown in this booklet. The adoption of scientific protection is urged.

Speed Reducers. The Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill. Spur gear reducers and worm gear reducers made by this company and trade named IXL are shown in this recent catalog. Illustrations show specific instances where these machines are used and there are also detail pictures.

Motors. The Ohio Electric & Controller Co., 5900 Maurice Ave., Cleveland, Ohio. The motors made by this company are illustrated and described in Bulletin 204 that has been issued. Diagrams, specifications and dimensions are all contained in this booklet.

Automatic Machines. The Cleveland Automatic Machine Co., Cleveland, Ohio. Specific instances where this well known automatic is used are shown in this production bulletin. Treatise No. 5. The Shafer Bearing Co., the R. D. Nuttal Co., the Bower Roller Bearing Co., the Advance-Rumley Co., the Dort Motor Car Co. and many other factory interiors are shown in which the Cleveland Automatic has been used for a number of years—in some cases 22 years.

Air Hoists and Trolleys. The Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. Illustrations show and text describes the products of this company. Seven different styles of hoists and two styles of trolleys are shown in the folder.

Lubricators. The McCord Radiator & Manufacturing Co., Detroit, Mich. The importance of better lubrication in industrial development is pointed out in this booklet that has recently been mailed out. The theme is well worked out and of interest to industrialists in all lines.

Sawmill Machinery. The Clark Brothers Co., Olean, N. Y. An export edition of the company's catalog has been issued in which diagram drawings, clearly defined illustrations of the products and tables showing accomplishments are to be found as well as the text describing the products.

Cutting Tools for Gray Planers. The G. A. Gray Co., Cincinnati, Ohio. The right tools and the way to use them with this company's product are the subjects discussed in a new folder recently issued. Diagrams are used to show how the best results may be obtained on the planers.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Motors, small drills, and electric hammers. Toronto, Canada. Purchase or agency. Reference No. 10,314.

Engines and mechanical articles. Khartum, Africa. Agency. Reference No. 10,363.

Lathe and drill chucks. Sydney, Australia. Agency. Reference No. 10,355.

Machinery. Batavia, Java. Purchase and agency. Reference No. 10,360.

Forthcoming Meetings

Foreign Trade Council. Eleventh annual convention at Boston, June 4, 5 and 6. O. K. Davis, India House, Hanover Square, New York City, secretary.

Gas Products Association. Tenth annual meeting, June 10, 11 and 12. Ambassador Hotel, Atlantic City, N. J. C. T. Price, secretary and treasurer, 140 S. Dearborn St., Chicago, Ill.

The General Committee of Division V, Mechanical of the American Railway Association. Convention and exhibits. Atlantic City, June 11-18, 1924. V. R. Hawthorne, secretary, 431 S. Dearborn St., Chicago, Ill.

Railway Supply Manufacturers Association. Exhibit. Atlantic City, June 11-18, 1924.

American Society for Testing Materials. Twenty-seventh annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J. Week of June 23. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

Society of Automotive Engineers. Summer Meeting. June 24, 25, 26 and 27. Spring Lake, N. J. C. F. Clarkson, secretary, 29 W. 39th St., New York City.

American Society for Steel Treating. Sixth Convention, Boston, Mass., Sept. 22, 23, 24, 25 and 26. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Twenty-eighth annual convention. Milwaukee, Wis. Week of Oct. 13, 1924.

Management Week. Under the auspices of the American Society of Mechanical Engineers. Week of Oct. 20, 1924. New York City.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel.—Improvement in pig iron demand; the few large tonnage purchases now in the market have not caused any changes in published price schedules. Trend of the iron and steel scrap market upward. Steel bars holding at $2.20@$2.25 per 100 lb., f.o.b. mill; shapes are $2.25@$2.30 with $2.10 mentioned; plates quoted at $2@$2.25 per 100 lb., Pittsburgh. Hoop steel down 60c. and soft steel bands, 30c. per 100 in New York warehouses during week.

Non-Ferrous Metals.—Tin is the only non-ferrous metal to show a price advance in this week's market; quotations went up ¼c. per lb. in New York during week; the rise is a reflection of higher prices abroad. Copper inquiries better; consumers' stocks low. Although present lead prices are ⅛c. per lb. below last week, this metal leads market in demand. Zinc firm at present level.

(All prices as of May 29)

IRON AND STEEL

PIG IRON—Per gross ton—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$25.05
Northern Basic	24.00
Southern Ohio No. 2	24.00
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.00
BIRMINGHAM	
No. 2 Foundry	22@23
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.25
Virginia No. 2	28.17
Basic	24.00
Grey Forge	24.00
CHICAGO	
No. 2 Foundry local	24.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	27.00
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	25.77
Basic	25.77
Bessemer	26.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh	New York	Cleveland	Chicago
No. 10	$2.80@3.00	4.34	3.65	4.00
No. 12	2.90@3.10	4.39	3.70	4.05
No. 14	3.00@3.20	4.44	3.75	4.10
No. 16	3.20@3.40	4.54	3.85	4.20
Black				
Nos. 17 and 21	3.50@3.70	4.65	4.35	4.55
Nos. 22 and 24	3.55@3.75	4.70	4.40	4.55
Nos. 25 and 26	3.60@3.80	4.75	4.45	4.60
No. 28	3.65@3.85	4.85	4.55	4.70
Galvanized				
Nos. 10 and 11	3.80@4.00	4.90	....	4.60
Nos 12 and 14	3.90@5.10	5.00	....	4.70
Nos 17 and 21	4.20@4.40	5.30	....	5.00
Nos. 22 and 24	4.35@4.55	5.45	5.10	5.15
No. 26	4.50@4.70	5.55	5.35	5.30
No. 28	4.80@5.00	5.85	5.65	5.60

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	48%	34%	55½%	43½%	50%	37%
2½ to 6 in. steel lap welded	44%	30%	53½%	40½%	47%	34%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 34% off.

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ½-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
½	$0.09	50%	⅞	$0.16	35%
⅝	.11	45%	1	.18	31%
¾	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.53	8.00	6.70
Hoop steel	4.59	4.66	4.55
Cold rolled strip steel	7.50	8.25	7.40
Floor plates	5.80	5.66	5.80
Cold drawn shafting or screw	4.40	4.10	4.00
Cold drawn flats, squares	4.90	4.60	4.50
Structural shapes (base)	3.59	3.46	3.30
Soft steel bars (base)	3.49	3.36	3.20
Soft steel bar shapes (base)	3.49	3.36	3.20
Soft steel bands (base)	4.09	3.61	3.95
Tank plates (base)	3.59	3.46	3.30
Bar iron (3.00 at mill)	3.49	3.36	3.20
Tool steel	11.00	....	....
Drill rod (from list)	60%	40@55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			13.25
Tin, 5-ton lots, New York			41.00
Lead (up to carlots), St. Louis	6.85	New York	7.50
Zinc (up to carlots), St. Louis	5.65	New York	6.50

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	27.00	30.00	28.50
Antimony (Chinese), ton spot	9.00	10.75	10.00
Copper sheets, base	20.25	20.25@20.50	23.00
Copper wire, base	15.50	18.25	16.25
Copper bars, base	19.25	21.50	19.50
Copper tubing, base	22.25	26.50	23.00
Brass sheets, base	16.75	21.00	18.75
Brass tubing, base	21.00	26.00	20.50
Brass rods, base	14.50	17.00	15.75
Brass wire, base	17.25	21.00	....
Zinc sheets (casks)	10.75	10.75	....
Solder (½ and ½), (case lots)	34.75	30.00	30.00
Babbitt metal (83% tin)	60.00	53.00	48@52
Babbitt metal (35% tin)	28.00	17.50	23@26
Nickel (ingot and shot) f.o.b. refinery	27.00	....	....
Nickel (electrolytic) f.o.b. refinery	30.00	....	35.00
Nickel (F shot) f.o.b. refinery	30.00	....	....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b Huntington, W. Va.:

Rolled nickel sheet (base)	52.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Shop Materials and Supplies

METALS—Continued

Manganese nickel hot rolled rods "E"—low manganese (base) 54. 00
Manganese nickel hot rolled rods "D"—high manganese (base) 57. 00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32. 00	Hot rolled rods (base)	40. 00
Blocks	32. 00	Cold drawn rods (base)	48. 00
Ingots	38. 00	Hot rolled sheets (base)	42. 00

OLD METALS—Dealers' purchasing prices in cents per pound

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00@10. 75	10.00	10. 75
Copper, heavy, and wire	9. 62½@10. 50	9. 50	10. 00
Copper, light, and bottoms	8. 50@ 9. 00	8. 50	9. 00
Lead, heavy	5. 62½@6. 00	5. 00	6. 50
Lead, tea	4. 37½@5. 00	3. 00	5. 50
Brass, heavy, yellow	6. 50		6. 50
Brass, heavy, red	8. 50 @8. 75	8. 75	8. 50
Brass, light	5. 75	4. 50	6. 00
No. 1 yellow brass turnings	6. 50 @6. 75	5. 50	6. 50
Zinc	3. 50 @3. 75	3. 50	3. 50

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$24. 30	$22. 85	$18. 50
"A" Grade:				
IC,	20x28, 112 sheets	20. 20	18. 00	17. 00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	14. 00	13. 00	14. 50
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	8. 25	6. 55	7. 40

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0. 14@0. 21	$0.20	$0. 14
Cotton waste, colored, per lb.	. 09@ .12½	.17	. 10½
Wiping cloths, 13¼x13¼, per lb	11. 50	36. 00 per M	. 16
Wiping cloths, 13¼x20½, per lb.	....	52. 00 per M	. 16
Sal soda, per 100 lb.	2. 40	2. 25	2. 65
Roll sulphur, per 100 lb.	3. 60	3. 25	3. 50
Linseed oil, per gal., 5 bbl. lots	. 98	1. 07	. 94
Lard cutting oil, 25% lard, per gal.	. 55	. 50	. 79*
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.29	. 35	. 40
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 2c. per sq.in., per ply:			
Medium grade	40–2½%	30–10%	30–10%
Heavy grade	30–5%	30%	20–5–2½%
Rubber and duck:			
First grade	50%	50–10%	40–10%
Second grade	50–5%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5. 40	$5. 84	$6. 48
Emery paper	9. 90	11. 00	8. 80
Emery cloth	31. 12	31. 12	29. 48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1. 49	1. 24	1. 40
Cloth	3. 38	2. 67	3 20
Fire clay, per 100 lb. bag		. 65	. 60
Coke, prompt furnace, Connellsville	per net ton		3. 75@4. 00
Coke, prompt foundry, Connellsville	per net ton		4. 75@5. 50
White lead, dry or in oil	100 lb. kegs		New York, 15. 00
Red lead, dry	100 lb. kegs		New York, 15. 00
Red lead, in oil	100 lb. kegs		New York, 16. 50

*Chicago quotes on pure lard oil, No. 1 grade.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0349	$0.0349	$0.0354
Cold finished shafting	per lb.	0.044	0.044	0.044
Brass rods	per lb	0.145	0.155	0.1875
Solder (½ and ½)	per lb.	0.3475	0.39	31.50@33.50
Cotton waste	per lb.	.14@.21	.14@.21	.10@.13
Washers, cast iron (½ in.)	per 100 lb.	6.50	6.50	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.02
Lard cutting oil	per gal.	0.55	0.55	0.60
Machine oil	per gal.	0.29	0.29	0.297
Belting, leather, medium	off list	40–2½%	40–2½%	30–10%
Machine bolts up to 1x30 in.	off list	50%	45%	30%

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	50%	60–10–5%	55–5%
1½ and 1½x3 in. up to 12 in	15%	60%	50%
With cold punched hex. nuts up to 1 in. diam. (plus std. extra of 10%)	35%	$3. 50 net	.....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	45%	3. 50 net	$4. 00 off
Button head bolts, with hex. nuts	List net	List net	3. 50
Hex. head and hex. nut bolts	List net	.....	List plus 10%
Lag screws, coach screws	50%	.....	50–5%
Square and hex. head cap screws	75%	75%	75–5%
Carriage bolts, up to 1 in.x30 in.	40%	60%	50–5%
Bolt ends, with hot pressed nuts	50%	.....	55-5%
Tap bolts, hex. head, list plus	35%	.....	.....
Semi-finished nuts, ⅝ and smaller	70%	.....	.....
Semi-finished nuts, ¾ and larger	65%	70%	80%
Case-hardened nuts	50%	.....	.....
Washers, cast iron, ½ in., per 100 lb. (net)	$6. 50	$4. 00	$4. 00
Washers, cast iron, ⅝ in., per 100 lb. (net)	5. 50	4. 00	4. 00
Washers, round plate, per 100 lb. Off list	1. 50	4. 50	4. 00
Nuts, hot pressed, sq., per 100 lb. Off list	1. 50	4. 00	3. 50
Nuts, hot pressed, hex., per 100 lb. Off list	1. 50	4. 00	3. 50
Nuts, cold punched, sq., per 100 lb. Off list	1. 50	4. 00	3. 50
Nuts, cold punched, hex., per 100 lb. Off list	1. 50	4. 00	3. 50
Rivets:			
Rivets, ⅞ in. dia. and smaller	50%	60–10%	60%
Rivets, tinned	50%	60–10%	4½c. net
Button heads ⅞-in., ¾-in., 1x2 in. to 5 in., per 100 lb. (net)	$5. 00	$3. 50	$3. 75
Cone heads, ditto (net)	5. 20	3. 60	3. 95
1½ to 2-in. long, all diameters, *EXTRA* per 100 lb.	0. 25	.....	0. 15
⅝ in. diameter *EXTRA*	0. 35	.....	0. 15
½ in. diameter *EXTRA*	0. 75	.....	0. 50
1 in. long, and shorter *EXTRA*	0. 75	.....	0. 50
Longer than 5 in. *EXTRA*	0. 50	.....	0. 25
Less than 200 lb. *EXTRA*	0. 50	.....	0. 50
Countersunk heads *EXTRA*	0. 45	.....	$4. 20 base

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Conn., Hartford—Capitol Coal Co., 340 North Front St.—conveying machinery.

Conn., Hartford—F. J. Trinder, State Dir. Vocational Educ., State House—wood and metal working machinery for proposed trade school at Middletown.

Conn., New Haven — Electro Thermal Mchy. Co., 82 Church St., J. E. Perry, Pres.—one 10 ton crane.

Conn., Norwalk — School Comn. — wood and metal working tools for proposed $200,000 junior high school.

Ky., Louisville—Office of United States Engineer, P. O. Box 72—combined punch and shear machine, belt driven.

Md., Cumberland—McKaig Mchy. Exch. —electric welder, stationary or portable, motor or gas.

Mass., Boston—Bay State Radio Co., 22 Hanover St.—light machinery and woodworking equipment.

Mass., Boston—W. H. Field, 39 Washington St., North (woodworking machinery) —two 5 ton hand power operated cranes, to cover area of 2 bays, 26 x 200 ft. each.

Mass., Roxbury (Boston P. O.)—C. L. Berger & Sons, 37 Williams St.—equipment for factory for the manufacture of surveying instruments.

Mich., Detroit—Viking Pump Co., 642 Beaubien St., J. B. Huyck, Purch. Agt.—machinery and equipment for new plant at Windsor, Ont.

Mich., Menominee—S. Crawford & Sons—lath mill and bandsaw.

Mo., Joplin—Roberts Lamphin Machine Co., 708 Joplin St.—No. 1 or 2 Universal milling machine; crank shaft grinder; 18 to 22 in. lathe; single spindle, 22 to 24 in. drill press (used).

N. Y., Buffalo—Iroquois Door Co., 629 Exchange St.—electrically operated machinery for planing mill.

N. Y., Lackawanna (Buffalo P. O.)—Buffalo Brake Beam Co., W. B. Chaffee, Mgr.—machinery and equipment for forge plant.

O., Columbus—Stitt Ignition Co., 16 East 1st Ave. (manufacturer of spark plugs), M. H. Spring, Genl. Mgr.—6 spindle automatic machine for various operations.

O., Columbus—V. W. Ventilator Co., 315 Wesley Block (manufacturer of Pullman ventilators), C. M. Shigley, Mgr.—metal working equipment for proposed plant.

O., Toledo—Toledo Radiator Co., 1102 Monroe St.—one power hammer for light sheet metal work (used).

Ore., Portland—Electric Steel Fdry. Co., 24th and York Sts.—electric furnaces, cranes and ladles for proposed foundry.

Pa., Braddock—Bd. Educ.—two lathes, hacksaw, shaper, blacksmith forge and annealing furnace.

Pa., Norristown—McCarter Iron Wks., Inc.—one 30 or 40 ft., 5 or 10 ton crane.

Pa., Pittsburgh — Amer. Sheet & Tin Plate Co., Frick Bldg., M. S. Dennis, Purch. Agt.—50 ton crane, 10 ton auxiliary, 80 ft. span.

Pa., Pittsburgh — Koppers Co., Union Trust Bldg.—locomotive cranes, shovels and buckets.

Pa., Pittsburgh—Universal Portland Cement Co., Frick Bldg.—boring mill, lathe, milling machine and 36-in. planer.

Tex., Houston—H. L. Washburn, Auditor Harris Co.—receiving bids until June 12 for machine shop tools and equipment.

W. Va., Huntington—J. J. Weiler & Sons, Robson-Prichard Bldg. (steel fabricators) —bolt cutter, straightening and bending machine, 24 in. beam capacity.

W. Va., Moundsville—W. F. Burgess—repair equipment for garage.

W. Va., St. Marys—R. W. Russell—one 1,500 lb. board left drop press, two bolt heading machines, one scrap baling press, three power hammers, one 2 stage air compressor and one rotary shear for ½ in. plate.

Wis., Clintonville—Patterson Mfg. Co., R. H. Haase, Purch. Agt.—machine tools, including lathe, grinder and drill presses, for the manufacture of a motor drive and appliances.

Wis., Milwaukee—Central Bd. Purchases, City Hall—planer.

Wis., Milwaukee—McClymont Marble Co., 27th and Canal Sts., J. McClymont, Purch. Agt.—one electric stiff arm drill with in and out movement.

Wis., Neillsville—Clark Co., O. J. Weyhmiller, Hy. Comr.—machine tools and equipment for proposed $40,000 machine shop for the repair of road equipment.

Man., Brandon—Kinley & Cassau—equipment for automobile repair shop.

N. B., Bathurst—Gloucester Lumber & Trading Co., Ltd., W. G. White, Purch. Agt.—complete equipment for sawmill.

N. B., St. John—Maclean & Holt Co., Ltd., J. L. McAnty, Purch. Agt.—complete equipment for moulding shop and foundry.

N. S., Yarmouth—Parker, Eakins & Co. —complete equipment for sawmill at Meteghan, to replace fire loss.

Ont., Bracebridge—J. C. Kinney—equipment for garage and automobile repair shop.

Ont., Hamilton—C. W. Petrie Cream Separator Co., Ltd., Lottridge St.—machinery and equipment for new plant at Orangeville.

Ont., Huntsville—G. Olan—Sawmill machinery.

Ont., Kingston—M. Milners, 55 Colborne St.—machinery for machine shop.

Ont., Kingston—Warren & Williams, 110 Clergy St.—equipment for garage and automobile repair shop.

Ont., Solway — E. O'Connor — complete equipment for sawmill at Walkerton.

Ont., Sprucedale—H. D. Farrell—sawmill machinery.

Que., St. Laurent—A. Bonin, 74 Principale St.—equipment for automobile repair shop.

Opportunities for Future Business

Calif., Emeryville—The Letts Oliver Investment Co. awarded the contract for the construction of a factory on Park Ave. Estimated cost $42,000. Western Electric Co., 680 Folsom St., San Francisco, lessee.

Calif., Long Beach—The Pacific Coast Steel Co., Rialto Bldg., San Francisco, is having plans prepared for the construction of first unit of steel mill, including blast furnace, etc., here. Ultimate cost $7,000,000. Private plans.

Calif., Los Angeles—The Albertson Motor Co., 1540 South Figueroa St., awarded the contract for the construction of a 1 story, 100 x 125 ft. service plant on Pasadena Ave. and Ave. 50. Noted May 22.

Calif., Los Angeles—The Wiley Machine Co., 440 Seaton St., awarded the contract for the construction of a 1 story, 80 x 120 ft. factory.

Calif., Oakland—The Knapp Metal Barrell Co. of the Pacific Coast, Balboa Bldg., San Francisco, plans to build a factory for the manufacture of metal locking head barrels, at Parr Terminal, here.

Calif., San Francisco—The Amer. Can Co., 120 Bway., New York, awarded the contract for the construction of a 3 story machine shop on 17th and Florida Sts., here. Estimated cost $300,000.

Conn., New Haven—The Electro Thermal Mchy. Co., 82 Church St., is having plans prepared for the construction of a 1 story, 88 x 182 ft. factory. Estimated cost $50,000. J. E. Perry, Pres. D. Smith, c/o owner, Archt. F. W. Thompson, c/o owner, Engr.

Ill., Granite City—The St. Louis Coke & Iron Co., 117 North 4th St., St. Louis, Mo., will soon receive bids for the construction of a blast furnace, etc., here. Estimated cost $2,500,000. W. G. Maguire, Pres. Private plans. Noted Feb. 1.

Ky., Louisville—The Standard Sanitary Mfg. Co., 6th and A Sts., awarded the contract for the construction of a 1 story, 140 x 180 ft. foundry. Estimated cost $90,000. Noted May 22.

Mass., Boston—J. C. Pushee & Sons, Randolph St., manufacturers of brushes, are receiving bids for the construction of a 5 story, 65 x 133 ft. factory, etc. Estimated cost $200,000. Monks & Johnson, 99 Chauncy St., Archts.

Mass., Cambridge—Irving & Casson, 573 Boylston St., Boston, awarded the contract for the construction of a 1 and 2 story, 65 x 100 ft. addition to furniture factory, with 20 x 50 ft. wing, here. Estimated cost $100,000.

Mass., Charlestown (Boston P. O.)—The Merchants Terminal Co., Medford, Vt., awarded the contract for the construction of a 1 story, 55 x 107 ft. garage and machine repair shop. Estimated cost $40,000.

Mass., Marlboro — The Marlboro Wire Goods Co. is having plans prepared for the construction of a 3 story, 70 x 150 ft. factory. Cost from $150,000 to $170,000. Private plans.

Mass., Roxbury (Boston P. O.)—C. L. Berger & Sons, 37 Williams St., awarded the contract for the construction of a 2 story, 60 x 70 ft. factory for the manufacture of surveying instruments. Cost will exceed $50,000.

Mich., Detroit—Brown & Derrick, Archts., 120 Madison Ave., will receive bids until June 14 for the construction of a 5 story (ultimately 8 story), 125 x 145 ft. garage on Beaubien and Congress Sts., for Detroit Garages, Inc., 320 Ford Bldg. $250,000.

N. Y., Niagara Falls—The International Cooperage Co., Erie Ave. and 9th St., plans to rebuild its plant which was destroyed by fire. Estimated cost $100,000.

O., Columbus—The Columbus Trunk Co., Dublin Rd. and Scioto River, is having plans prepared for the construction of a 2 story, 60 x 100 ft. factory. Estimated cost $60,000. P. D. Howard, East Broad St., Archt.

O., Columbus—Lockwood, Green & Co., Engrs., Hanna Bldg., Cleveland, are receiving bids for the construction of a 3 story, 100 x 240 ft. manufacturing building, 50 x 360 ft. forge shop, 50 x 167 ft. steel storage and 50 x 117 ft. hot bolt shop, for the Columbus Bolt Wks., Water and Chestnut Sts., here. Noted May 15.

O., Columbus—The V-W Ventilation Co., 315 Wesley Block, is having plans prepared for the construction of a 2 story factory on West Rich St. Estimated cost $40,000. Private plans.

Ore., Portland—The Electric Steel Fdry. Co., 24th and York Sts., will build a 1 story, 50 x 160 ft. foundry.

Ore., Portland—Meier & Frank, Meier & Frank Bldg., awarded the contract for the construction of a 4 story, 113 x 200 ft. automobile terminal, warehouse and repair shop at 294 East Water St. Estimated cost $165,000.

Pa., Phila. — The Genl. Electric Co., Witherspoon Bldg., awarded the contract for the construction of a 6 story, 105 x 604 ft. plant on Elmwood Ave. between 68th and 70th Sts. Estimated cost $1,000,000.

Tex., Dallas—The Ford Motor Co., Highland Park (Detroit, P. O.), Mich., awarded the contract for the construction of a 1 story, 301 x 840 ft. assembly plant, etc., on East Grand Ave., here. Estimated cost $1,000,000. Noted Apr. 17.

Wis., Oconto—The Holt Hardwood Co. will build a 1 story, 72 x 302 ft. mill. Noted May 15.